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TOWARDS HEALTH

J. Arthur Thomson

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Towards Health

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To

Towards Health

By

J. Arthur Thomson

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Regius Professor of Natural History in the University of Aberdeen

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With Four Diagrams

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PREFACE

THE aim of this book is to explain the biological ideas that underlie the study of health. There are numerous excellent guides to personal health and there are valuable treatises on social hygiene, but this contribution to one of the most important of subjects has a quite different intention; it seeks to explain the fundamental principles involved. The chapters formed a series of popular Saturday Evening Lectures (Farquhar Thomson Lectures) delivered annually by members of the Medical Faculty of the University of Aberdeen, the intention of the Trust being to promote the cause of health among the people. It is with that hope that we seek for our lectures a wider audience.

J. A. T.

April, 1927

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Towards Health

CHAPTER I

THE BIOLOGY OF HEALTH

§ 1. What Health Means

Just as peace means much more than the absence of war, so health means much more than the absence of disease. For health is a positive quality, implying harmony of function, vigour, and a quiet joy. The healthy man has a wholeness or oneness of physical life, while the unhealthy man is always distracted. And though the healthy man may be torn by temptations and puzzled by the unsolved problems of life, he has not often to fight a battle with two fronts, for health implies some degree of unity. The unhealthy man, on the other hand, has always to face bodily discord as well as ethical and intellectual difficulties. He is not at peace with his own body. It is for practical purposes impos-

sible to separate the healthy mind from the healthy body, for while a man may be healthy without being clever or learned, he cannot be quite healthy without having a clear head and good feelings. One cannot press the converse proposition, for many people who have weakly or diseased bodies rise to lofty heights of healthy-mindedness. Yet, on the whole, it must be admitted as a fact of experience that the absence of bodily health often implies some twist or deterioration of mind and morals. The experience of ages has confirmed the validity of the ideal, more honoured in quotation than in endeavour, *mens sana in corpore sano.*

§ 2. Enthusiasm for Health

Man has a deeply-rooted admiration for physical fitness and prowess, going back no doubt to prehistoric times when these qualities were of obvious survival value. Before large societies had arisen, with their kindly, yet often baleful power of extending their protective shield over under-par individuals, who would otherwise have been speedily wiped out in the struggle for existence, there was necessarily a premium on health, and rewards of leadership and the like went to those who excelled in vigour

and initiative. The ancient admiration for these qualities is still happily strong in our midst, though it often unfortunately exhausts itself in passive applause without any active sharing. The athletic fervour among adults is too often that of mere bystanders. We get nearer the primary enthusiasm among young players; and in many schools the standard of fitness is pitched high, and sustained by a wholesomely keen public opinion.

But enthusiasm for health is not only native to the healthy-minded, it has a reasonable basis. Health is halfway to happiness. It is more than halfway to that form of happiness which is the reflex of harmonious and unified activity. Disease always means discord and disunion. The heaviest burden of depression and despair that has ever weighed man down is the inevitable nemesis of the diseased state brought about by hookworm parasites. Inevitable in the sense that as long as the parasites are present the sufferer cannot but be depressed, de-vitalised, despairing. Fortunately, as we shall see, the cloud is lifting.

Bodily health brings its own reward—the thrill of vigour, the light step, the enjoyment of endurance, the readiness for adventure; but it also brings the higher happiness of a clear head, with an appe-

tite for good intellectual fare; it means some capacity for enjoying the good things of life—the sunshine, the open air, the country, the birds and flowers; it also means some surplus energy to spare for one's friends. We lose our health, and how changed is everything. Initiative goes, the grasshopper becomes a burden, we seek lines of least resistance, the spots in our eyes blot out the sun, the sky is all clouds, we become pre-occupied with our ailments, we are carriers of the germ of unhappiness.

Health has also an ethical value, not only because it means some measure of unification of life, not only because it is easier to be of good will if one is of good health, not only because it gives man a freedom for higher adventures, but also because it is such a sure touchstone of good and evil. Positive health is a very reliable criterion of morals. For a large proportion of his ailments every man knows that he has himself to blame. Sluggishness and over-strain, narcotising and over-stimulation, gluttony in solids and liquids—all are so obviously in defiance of the laws of health, that we are amazed at our own folly. Even if it be urged that many common ailments are the results of microbic infection which cannot be avoided, it must be answered,

if we are honest, that we often lower our resisting power by lack of exercise or by coddling ourselves in hot rooms and inside an absurd stratification of clothes.

It is quite true that a restless mind or the spur of ambition or devotion to a good cause may lead to overwork and its unhealthy consequences, but this is only to plead exonerating circumstances. Every one knows that man's first duty is to keep healthy, unless perhaps in rare cases, like the doctor in a plague, when it may seem worth while to jettison health in order to save other people.

One cannot pretend that virtues will grow in proportion to health, for the more vigorous man often has stronger urges and appetites than the less vigorous. It is not unnatural that a very vigorous man should be highly sexed, though this is by no means always the case. But this much may be said, that a high ideal and attainment of positive health, while not weakening the imperious demands of the sex-urge, will render the formation of bad sex-habits extremely unlikely. To the widely circulated falsehood that continence is necessarily prejudicial to a man's health, we shall refer later.

The other great reason for enthusiasm for health is economic, and appeals to our patriotism. For

the prosperity of a country depends on its industry, and the annual loss to industry through direct ill-health is appalling. To direct loss through absence from work through illness has to be added the inferior workmanship and lowered output that bad health entails. Moreover, bad health is apt to lead to the abuse of stimulants, with familiar consequences. Deeper still, bad health or depressed vitality favours acquiescence with conditions of life, such as housing, against which vigorous men and women would rebel.

§ 3. The Biological Outlook

Medical advice in regard to individual health and social hygiene we are familiar with and grateful for, but what can biology have to say? Yet would it not be strange if the science of organic life had no counsel for us in our endeavour after more life and better life? We hope to show that it has much to suggest, but just because human society is more than a herd of mammals, we give prominence at the outset to the warning that the biological outlook is necessarily partial, and requires to be supplemented and corrected by psychological and sociological considerations. *We must take an all-round view.*

Thus we cannot separate the healthy body from the healthy mind—the psychologist must advise us; moreover, all our biological ambitions seek realisation within a social phase—the outcome of an industrial and palæotechnic age—which is much stronger than the individual. The sociologist must advise us. The biologist as such has not directly to do with mental training, and yet the attention given to his counsel depends largely on education. For it is plain that the value of biological advice might be greatly increased if people "changed their mind." Similarly what is biologically desirable is not always socially desirable. As Sir Francis Galton always insisted, biologists must respect the existing state of social sentiment. The biologist as such is not directly concerned with improvements in social organisation, and yet he knows that the edge is taken off his advice by obstacles that are social rather than organismal. While the biologist must hold to his ideals, he must anticipate the difficulties of realising these in the present-day psychological and sociological conditions. In short, there is an inevitable and indispensable co-operation of the higher sciences when we face a vast problem like health.

What, then, is the biologist's task in relation to the health of the community? He sees around him

diverse aggregates and integrates of men, women, and children with varying degrees of healthfulness and with diverse natural inheritances. What suggestions has he to offer towards betterment? He sees a great variety of activities and inactivities, some much less wholesome than others: has he, as biologist, any advice towards amelioration? He sees a variety of environments, plus and minus again, from the hills and dales to the slum: has he, as biologist, any suggestions towards improving or towards holding fast that which is good, even towards making the best of the worst? In other words, as will become plainer later on, the biological prism for the analysis of life has these three sides, *Organism, Function, Environment;* or, in human terms, *Folk, Work, Place.* The hope is that some practical progress may reward clearer understanding.

In looking towards the future we are grateful for what has been achieved in the past. It is surely a big thing if a British child of 1927 has an expectation of life twelve years more than a child of 1827. There have been great advances in sanitation and preventive medicine, and from time to time there have been waves of enthusiasm towards better health. But the progress that has been made is to the credit of Medicine rather than of Biology, and

even if one recalls how zoologists have joined the ranks of medicine in fighting such diseases as malaria and sleeping sickness, to mention only two, one is bound to say that the help came from parasitologists, entomologists, and the like, rather than from biologists in the stricter sense. The contributions from biology are more difficult to specify, because they relate to clearer thinking rather than to practical advances. But it would be unwarranted pessimism to say that the biological study of heredity and environment, of sex and reproduction, has been without influence on human welfare. There is a large contribution even in the fundamental idea, which we venture to reiterate, stable progress must take account of the three sides of Life—Organism, Function, and Environment; Folk, Work, and Place.

§ 4. Good and Ill

We all recognise that there is considerable soundness and wholesomeness in ourselves and others. The facts forbid pessimism, but they do not encourage complacency. Keeping away from problems of social organisation, which are not for the biologist as such, we must all recognise that there

are grave reasons for taking counsel together. *What is wrong that we wish to help to put right?*

In the first place, there is far too much actual disease, which may be biologically described as disturbance of the normal routine of the body. When the ordinary processes of metabolism get out of hand, and occur out of place, out of time, and out of tune, that spells some sort of disease. Biologically speaking, we may distinguish constitutional diseases, occupational diseases, and parasitic diseases, and though the second and third are being resolutely and successfully tackled, there is still far too much of all three. Constitutional diseases, such as some forms of epilepsy and diabetes, appear to be due to inborn or germinal defects or disturbances, and the big fact, that should make us think, is that they are practically unknown in Wild Nature except when man interferes. The chief reason for this is that if they show face in Wild Nature they are nipped in the bud. Natural selection is all for health, but man has departed from Nature's régime of sifting without substituting anything better.

Occupational and habitudinal diseases, such as might be illustrated by lead-poisoning and extreme obesity, are likewise practically unknown in Wild

Nature, though common enough among domestic animals. The chief reason is to be found in Nature's stern selection for health and sharp intolerance of bad habits. A rat may live in a sewer, yet it is not an unhealthy rat. Most animals, save parasites, have a deeply rooted objection to deteriorative environment and functionings.

As to microbic diseases, such as tuberculosis and malaria, which are so rife in mankind, one must admit the occurrence of "epidemics" in Wild Nature, but there is not much evidence of their frequency except when man has intruded. It is possible that the horses which used to be so abundant in America were exterminated by some Trypanosome carried by some fly, but this is only a speculation. It is possible that some microbic disease hastened the puzzlingly rapid disappearance of the passenger pigeon, but this has not been proved. We venture to say that microbic diseases are quite exceptional in Wild Nature.

The critic may remind us of microbic and fungoid disease in salmon, of a kind of diphtheria among wood-pigeons, of the pébrine that is so fatal to silkworms, of "foul brood" among hive-bees, and so on through a long list, but in most cases it will be found that the conditions of these animal diseases are not

those of Wild Nature, but of human interference. There is a well-known bacterial disease among sandhoppers, well-known because such an occurrence is so unusual; but here, again, we must make sure that pollution by sewage or the like is not to blame.

If the critic refers to the Trypanosomes that occur abundantly in antelopes and other wild animals in Africa—Trypanosomes which are believed by many to be the same as those which cause sleeping sickness in man and nagana disease in domestic stock—the answer is, that these internal beasts-of-prey, as they should be called, seem to be almost harmless to their wild hosts. The exception proves the rule. Similarly, in regard to parasites, which are undoubtedly very common in Wild Nature, the usual state of affairs is that a give-and-take compromise is arrived at between the host and its parasites. Mutual adjustments bring about a *modus vivendi,* and in many cases the presence of numerous parasites is immaterial unless some other factor, such as scarcity of food, enfeebles the vigour of the host. When parasites rapidly destroy an animal, this is usually due to their getting into an entirely novel host that has no natural defences in the way of "anti-bodies" and so forth. We admit,

however, that troubles due to parasites may occur in Wild Nature apart from human interference; we maintain, on the other hand, the important thesis, that there is only a very rare occurrence of constitutional, habitudinal, or microbic disease.

§ 5. Contrast between Organic Nature and Civilised Society

The reasons for this striking and disconcerting contrast between civilised society and Wild Nature are briefly these: (1) That social conditions shield individuals who would be rapidly eliminated by natural selection; (2) that the progress of curative medicine makes cobbling practicable and enables man to evade natural penalties; and (3) that our health-conscience is very dull.

A second contrast between civilised society and Wild Nature is that the latter abounds in exuberant vigour, while the former shows an appalling diffusion of gloomy sub-health. It is plain that one must distinguish between the absence of disease, not that this would be a small thing, and *positive* health. Why is there so much depressed vitality in our midst? Partly because man is easily led astray from health by ambitions so strong that they force

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him to ignore or disregard the associated deterioration of physical vigour. Partly because of temporarily effective stimulants and fatigue-disguisers. Partly because there is in civilised mankind little of the resting instinct (*sit venia verbo*) that is so strong and imperative in many wild animals.

No naturalist, however optimistic, would maintain that Wild Nature is without anything corresponding to man's "unlit lamp and ungirt loin." For, quite apart from parasitism, there are many instances of animals that take things easily, drifting rather than swimming in the tide of life. But even among those animals that thus show implicit acceptance of such mottoes as "Ca canny" and "Safety first," there is very little indication of depressed health. The chief reason for this is to be found in the direct competition between organisms and in the struggle between organisms and their changeful environment. For this twofold endeavour is ever insistent on physical fitness. Man, however, is able in a large degree to evade this insistence, and thus depressed vitality becomes almost standardised.

A third, often painful, contrast between civilised society and "Wild Nature" is that the former shows so much pathology of sex and the latter so little. It

is true that there are some ugly sex-facts, even among wild animals, but they are not common; and on the whole one must say that if the animal never rises so high as man, it rarely falls so low, except in domestication. But why is it that "sex" is so often pathological in mankind, so rarely even ugly in, say, birds? Part of the answer is that social and ethical considerations lead to "repressions" and "suppressions" which bring dangers and troubles; but another part of the answer is that sex-selection in birds is largely determined by vigour, agility, and the ecstasy of health. There is too little of this kind of selection in mankind, and the lowered standard of health reacts on the expressions of sex.

The biggest fact that lies behind the contrasts that we have discussed is the difference between a human society and a herd. In man's case so much depends on the *extra-organismal heritage,* which is at once a blessing and a curse. The social heritage of customs and traditions, manners and morals, institutions and enregistered ideals, is indispensable to man, who cannot stand alone; yet it allows of the survival of organisms with a bad natural inheritance, and it brings to us from the past, and from the industrial palæotechnic age in particular, an objective and a subjective net in which we sometimes

seem, even at our best, to be struggling in vain. In a society the force of habits is raised to a higher power, and for evil as well as for good. In a society there are engendered ambitions and appetites (plus and minus again) whose intensity enables them to dominate over our vague "instincts" of physical health. Much of our disharmony is due to the rapidity of the social evolution, upwards and downwards, to which as organisms we have not had time to adjust ourselves, whether in acquiescence or in rebellion. It comes to this, that biological ideals, such as that of better health, cannot be fully realised without the aid of corresponding social ameliorations.

§ 6. Meliorism

We must take a balanced view, neither despairing nor complacent. Using our biological prism again — Environment, Function, Organism, or Place, Work, Folk—and taking that order for a change, we must admit that many human surroundings are infra-human. They are impoverished and impoverishing; they are ugly, depressing, and deteriorative. Yet how many present-day efforts there are towards open spaces, gardens, better

houses—even homes, developing the egress of cities —wholesome ways out of slumdom. It may be that the influences of wholesome surroundings are not hereditarily entailed, but they may mean heaven or hell for the individual.

As to functions, there are still occupations that are very hard on the man, but every year sees some improvement. The work of miners, for instance, which we cannot at present dispense with, would soon kill most of us, yet the health-rate of miners is not low. Occupational diseases are less common than fifty years ago; hours are better; work-places are more wholesome; holidays are more possible. Perhaps what is most wrong is that much of the functioning lacks *interest*—the interest of art and beauty and of representative share in rewards and the reverse. This mechanisation of man leads to depression and fatigue, and consequent artificial short-cuts out of both. Even in the country, where much of the work is in the open air, it may be too unrelieved, and the brain softens. But even these disamenities are passing with the disappearance of distance—whether through charabanc or wireless. Can anyone doubt the reality of betterment? Along with improved functionings must be included improved use of leisure time—more play

and less mere looking at it, more truly mind-resting hobbies, such as gardening, and music and Natural History. To tell the truth, man is not good at resting; yet we are moulded not only by what we do, but also by what we do not do.

Turning to the individual organism again, we must add to the frequency of disease and the acquiescence in sub-health, a considerable frequency of "bad habits" in connection with eating and drinking and sex. Who is quite free from them? Yet gluttony is probably waning and more attention is being paid to diet than ever before in the history of mankind. The social criticism of alcoholism is becoming more stringent, and occupational excuses for it are becoming less genuine. There is less and less of a Manchester from which the shortest way out must be found.

As to sex, every clear-headed person must admit that there is much that works against health and happiness, not to speak of progressive evolution. We must admit the deplorable continuance of prostitution, the frequency of venereal disease, the abnormal sensuality of many men, and the numbers of both sexes who sink into the captivity of bad habits. Many fine types are distracted by the disharmonies of the sex-urge; there are too many

selfish bachelors who practise only nominal celibacy; there are in our country far too many unmarried women—a disproportion which always lowers the standard of sex-selection on the woman's part. There are also social and economic (e. g. housing) factors that operate undesirably against early marriage. Much of this has its psychical aspect, for while it is difficult to get away from vague surmise, it is to be feared that civilised society suffers from a frequent materialisation of marriage, from a lowering of ethical standards, from too strong a love of pleasure and a growing unwillingness to endure hardness. It is often difficult to say when the bodily aspect of the organism leads, and when the mental; but they cling together, and the ideal is *mens sana in corpore sano.*

Bad health is so unhappy and sub-health so tiresome that we all seek after health. What need, then, to talk about it? The need is that we do not desire health with all our heart and mind, nor for our neighbours (in the New Testament sense) as much as we should. There have been prophets of health in the past, men like Edward Carpenter; we need them now. Even when we moderate our hopes in face of the social régime which enmeshes and entangles us, we cannot but feel that a refreshed

enthusiasm for health would be a powerful lever. It might even move society. We need a poet of physical fitness. In any case let us not fail to see the good side of games and sport, exploring, scouting, climbing, swimming, even gymnastics, breathing exercises, and the dance. How much in this generation has golf done towards the prolongation of vigorous life, and what a good example it is of the health-testing values of a game. Off your game usually means off your health. The poet of health being still to find, let us summarise the ideal scientifically.

(*a*) Besides making for happiness and efficiency, bodily health is of great importance in some other ways. There have been cases where a very healthy mind was tenant of a weakly or diseased body, but the rule is that bodily health works towards mental health, for the organism is a unity. Conversely, it is well known that something wrong with the eyes may blur the mental vision, and a touch of liver may spoil a philosophy.

(*b*) Depressed health or sub-health makes man acquiescent with dirt and ugliness, with inaction and muddy thinking. The extreme case is the apathy and despair, the so-called "tropical depression" seen in bad cases of hookworm infection;

but we need not go to the tropics to find instances of the inhibitions of life brought on either by some disease or by acquiescence in a low standard of health. A mote in the eye blots out the sun, an accumulation of waste products poisons the life. The irritability of dyspepsia breaks up families and friendships.

(*c*) It cannot be said that vigorous health will free a man from the troubles associated with the imperiousness of sex, but the vigorous man is less likely to form bad habits. Looking at the whole range of life, we venture to say that good health makes for morals as well as manners. If we are frank with ourselves, and are fairly normal to start with, we must admit that the healthful unity of the organism is an uncommonly testing touchstone of conduct.

(*d*) As to the economic value of healthfulness all are agreed. The loss to the output of the community through unnecessary illnesses is enormous, and every hard-working man or woman knows how the pitch of their health affects what they can get through in a day. But the influence of health is qualitative as well as quantitative, as has been proved experimentally in the artist's studio as well as in great productive enterprises.

In comparing Civilised Society with Wild Nature and recognising, as we must, that the former is full of disharmonies which are relatively rare in the latter, we must admit that the comparison is not altogether fair. In the first place, civilised society consists of a social system within one species, in which the extra-organismal heritage counts for almost as much as the natural germ-plasmic inheritance. In the second place, Wild Nature has been in process of evolution for many millions of years, whereas civilised society is relatively a thing of yesterday. Thus there has been time to sift out disharmonies and discords from Wild Nature, whereas the sifting is still very imperfect in Human Society. But just here is the meliorist outlook—the varying and the sifting are both going on.

§ 7. The Alphabet of Victory

Science is for life, not life for science, as Herbert Spencer well said. And Bacon was before him in the well-known sentence: "Science is a rich storehouse for the glory of the creator, and the relief of man's estate." What a noble outlook he had, for in regard to the founding of Solomon's House, which was a kind of Institute for Experimental

Evolution, he wrote: "The end of our foundation is the discovery of causes and the secret motions of things, and the enlargement of the bounds of human empire, to the effecting of all things possible." That expresses the modern scientific position in regard to all the limitations and inhibitions, maladies, and miseries of mankind: Face the facts; try to understand them, and control will follow.

We are thinking here more especially of medical and medico-biological triumphs which have led to the theoretical and practical mastery of many diseases. As every one knows, the striking modern change is that the emphasis is passing from curing to preventing; and when science places a method of prevention within man's grasp, it is man's own slackness that is at fault if the method is not used.

A is for Ankylostomiasis, a big mouthful of a word, better called hookworm disease. It is the cause of one of the heaviest mundane clouds that have ever rested on the human race, producing the "tropical depression" which travellers, missionaries, and employers have often deplored. The disease is widespread in warm countries, and is due to a contemptible little threadworm that enters the human skin through cracks in the bare feet and ensconces itself in the food-canal where it draws blood from

the lining membrane. The results are anæmia, weakness, emaciation, melancholy, lassitude, and despair. It is easy to conquer the disease when its nature is understood; the worms are readily expelled by doses of carbon-tetrachloride; and simple sanitary precautions can greatly lessen the risk of reinfection. Thanks to medical efforts, especially those of the Rockefeller Institute campaigners, the incidence of the disease has been reduced in some places from 25 to 2 per cent.

B is for Bilharzia, another little worm that causes painful and serious disease in man. Every third child born in Cairo gets bilharziasis, and in some places it is said that every third adult is infected. The microscopic larva, like a transparent forked thread, enters by cracks and abrasions in the skin, and it takes up its abode in the blood-vessels of the small intestine or of the region of the kidneys and bladder. There are three or four different kinds, and they spend their juvenile life in various species of water-snail, just as is the case with the distantly-related liver-fluke of sheep. During the War, when on duty in Egypt, where bilharziasis often occurred among our soldiers, Major Leiper was able to work out the life-history of the parasite and to show how the chances of infection could be

greatly reduced. The active, threadlike larvæ which pass out of water-snails and swim freely become inactive and die in water that has been drawn and kept still for thirty-six hours. We can understand how children are infected by paddling in the pools and soldiers by bathing heedlessly, and why bilharziasis should be common among washerwomen and among gardeners. But the essential victory has been won.

C is for CRETINISM, that pathetic state of arrested development in children which is due to inadequate activity of the thyroid gland. The child stops developing and becomes no more than a feeble caricature of humanity, but treatment with thyroid hormone derived from calf or sheep (or now being made synthetically) may supply the natural deficiency, set the development agoing again, and change the miserable cretin into a dancing, joyous elf.

It is too soon yet to say "C for Cancer," for this disease, one of the six great killers, still carries off every tenth one of us—"a dirty fighter," as a great authority said the other day, "mauling and torturing its victim" before finishing him. But the brilliant discoveries of Dr. Gye and Mr. Barnard show that the conquest of cancer has more than begun.

D is for DIPHTHERIA, which has now been brought under control by anti-diphtheritic serum, to the great reduction of the mortality among children. Or, it might stand for Diabetes, which is yielding before the insulin treatment, a method somewhat analogous to that employed in dealing with cretins.

E is for EXPECTATION OF LIFE, for a notable victory is indicated in the simple statistical fact that a child born in 1927 has an "expectancy of life" twelve years longer than that of a child born a hundred years ago. It is not necessary to go back nearly so far, for most of the signal improvement has been brought about in the course of the last generation. The advance is greatly to the credit of medical officers of health and the sanitary authorities, "mothers and babies" associations and "child-welfare" workers; but it must be noted that the marked increase of "life-expectancy" at birth is not sustained in the same degree as the age increases.

F is for FILARIA, a genus of threadworms, several of them the causes of much trouble to man. Thus *Filaria sanguinis hominis* swarms in the blood in warm countries and brings about serious disorders, often marked externally by swellings and

by coarsening of the skin (elephantiasis). It is always a step towards conquest to discover the life-history of the enemy, and it is known that the young stages of the "bloodworm" are spent in mosquitoes which infect man.

G is for GUINEA-WORM, another of these threadworms, *Filaria medinensis,* a threadworm that is very troublesome in warm countries. The female is of great length, up to 6 feet, and it may move considerably in the body. When mature it coils itself up underneath the skin. The irritation results in an ugly sore, which may become an opportunity for other intruders. Man is infected by drinking water which contains the common water-flea Cyclops, the preliminary host of "the fiery serpent."

H is for HORMONES, those potent chemical messengers which are liberated into the blood from the ductless or endocrinal glands, and exert an indispensable influence in regulating the functions of the body, some exciting and others soothing. The most important of these glands are the thyroid, the supra-renal, and the pituitary, but there are others. Two of the hormones have been isolated and also synthesised, namely, thyroxin from the thyroid and adrenalin from the supra-renals. H might also stand for Hookworm.

I is for INSULIN, a product of certain tissues included in the pancreas or sweetbread, and concerned with the proper treatment of the carbohydrate part of the food. The story is so instructive that we venture to give an outline of what every one should know about insulin, which is now used as a cure for the not uncommon disease of diabetes.

Protoplasm or living matter, "the physical basis of life," always contains some proteins, carbohydrates, fats, salts, and water. Proteins are complex nitrogenous carbon-compounds, such as white of egg, casein in milk, gluten in wheat, and legumin in peas. Their name means "of the first importance," and that is what they are; for a great part of the chemical routine of living consists in the building-up and breaking-down of proteins. Carbohydrates are compounds of carbon, hydrogen, and oxygen, and in most of them there are two atoms of hydrogen to one of oxygen—the water (H_2O) proportion. Sugars and starch, cellulose and gum are good examples. The fats and oils are also compounds of carbon, hydrogen, and oxygen, but they contain far less oxygen in proportion to the carbon than do the carbohydrates. Then there are by-

products and waste-products which can be extracted in water from living tissue, and are therefore called extractives. Thus there is the waste-product urea—the ashes of the living fires in higher animals; and there is the creatine that is formed in muscle or flesh. (In regard to the last, it may be recalled that Liebig reported that the muscles of a hunted fox contained several times the normal amount of creatine. It is to be feared, however, that this statement was more picturesque than true.) Fifthly, there are salts in living matter, which closely resemble the salts of the sea—where living creatures probably began—and, lastly, there is water, often 70 to 80 per cent. of the whole. If we were to mix up some white of egg, a little syrup, a little oil, and a good deal of water with a pinch of salts in solution, we should have a rough-and-ready imitation of the chemical composition of living matter, but there would be no life in it.

If the physical basis of life contains these proteins, carbohydrates, and fats; and if living means in its chemical aspect a great variety of interactions between the different kinds of substances that constitute the life-firm; and if the general tendency is for the complex to be exploded or broken down into

the simple; then what is lost must be regained in food; and we see that perfect food for animals must contain proteins, carbohydrates, and fats. Bread and cheese, a little butter and an apple, must be regarded as a perfect meal, though one does not wish it every day; and milk is obviously a quite perfect food—if it were not so fluid.

In the living body there is an intricate, rapid, and orderly chemical routine of up-buildings and down-breakings, oxidations and reductions, condensations and solutions, dehydrations and fermentations; and the whole well-ordered activity—bustle without hustle—is summed up in the indispensable word *metabolism*. Now when part of the metabolism is seriously disturbed, it spells disease. If we exclude the body's answers-back to intruding microbes and also exclude what it suffers directly from unwholesome habits and habitats, occupations and food, disease means that part of the metabolism is out of place, or out of time, or out of tune.

One form of the disease diabetes is known as diabetes mellitus (honey diabetes) in man, where something goes wrong with the body's arrangements for dealing with sugar. In normal life a very small percentage (0.03 to 0.05) of grape sugar or glucose is filtered out along with the urine; in diabetic

patients there is a large quantity. This means a great waste of nutritive material or fuel that the tissues should be absorbing and oxidising; it means that other materials have to be unduly drawn upon; it means sugar-poisoning. It is not necessary to discuss the origin of the over-abundant grape-sugar (manifested in the glycosuria). The central fact for our present purpose is that in diabetes the tissues have lost their normal power of incorporating and utilising the sugar in the blood.

The pancreas or stomach-sweetbread is the most powerful digestive organ in the body. Its ferments attack all the different kinds of food. But it also makes internal secretions or hormones which are of fundamental importance. By means of these chemical messengers the pancreas controls the glycogen-storing work of the liver and is continually doing something to the blood and the tissues that makes the utilisation of the sugar possible. When *some unknown cause* prevents the pancreas continuing that branch of its work which enables the body-engine to use its glucose fuel, then there is diabetes.

The united investigations of Dr. Banting and Mr. Best, Dr. Collip and Professor J. R. R. Macleod have led to the extraction of an active principle called "insulin" from the pancreas of vari-

ous animals such as ox and sheep. This has been prepared in a form suitable for injection into diabetic patients, and it has been proved that the foreign insulin thus introduced may make up for the failure of the patient's pancreas to produce insulin for itself. The chemical composition of insulin is unknown and it is uncertain whether it is produced, as seems probable, by what are called the "islands of Langerhans" in the pancreas, or by other parts of the same organ. What it brings about is not a "cure," but rather a compensation for an unnatural deficiency. What it does in the blood is to remove the excess of grape-sugar, but how it does it is still obscure. And so, as we have said, is the initial cause of diabetes. The utilisation of insulin promises to bring alleviation to a multitude of sufferers, and it is a fine illustration of "team work" that many investigators should have contributed to this recent "relief of man's estate."

I might also stand for IMMUNITY, and one of the great strides of modern medicine has been the artificial immunisation of the human body against various microbes and viruses.

J is for JENNER, that shrewd English physician, who thought out the device of vaccination to evade the scourge of smallpox. His method was to intro-

duce into man's circulation the vaccine of cowpox, a mild disease of the cow's udder, with the result that a successful blood reaction against the introduced material makes the blood more or less immune to the intrusion of the very dangerous virus of smallpox. This was a pioneer discovery pointing on to many others which have been thought out since.

K is for KOCH who discovered the tubercle bacillus and definitely placed "consumption" on the list of diseases which are due to the lesions and poisons produced by microbes. This was a particular case, but a very important one, of Pasteur's Germ-Theory of disease. It is a commonplace nowadays, but it was a step of world-wide importance when it was definitely demonstrated that this great scourge of mankind was due to the intrusion of a definite living organism—and not a vague mystery.

L is for LISTER, who introduced, against much opposition and indifference, the aseptic methods of modern surgery. That is to say, he recognised that the serious evil effects often consequent on operations were due to the intrusion of microbes from the instruments used, or from the clothing of the surgeon, or from the operating table, and so forth. By the use of carbolic spray and other antiseptics

the omnipresent bacteria can be destroyed, and the wounds heal quickly.

M is for MALARIA, which has been one of the great scourges of mankind. It is due to the introduction of a microscopic animal—*Plasmodium*—into man's blood by the bite of an infected mosquito, which has acquired the germ by biting a malaria patient. Quinine increases man's resisting power, but the line of promise is to abolish pools of stagnant water in which the larval mosquitoes live. If that is impossible a film of oil on the surface prevents the larvæ from breathing. If that is impossible minute fishes should be introduced into the reservoir.

N is for "NERVES," an irritable state of the nervous system, sometimes associated with an extremely fatigued state known as neurasthenia. It often means a poisoning of the nervous system with some fatigue-toxin or worry-toxin, or it may be due to the overwork of some particular centre, whose cells undergo disintegrative changes. But "nerves" may be of use as a warning against something much worse.

O is for OBESITY or over-stoutness, often a handicap to health. It is mainly the nemesis of too little

muscular exercise, and it may be exaggerated by taking too much of certain kinds of food. There seems to be no ready way of getting rid of a surplus deposition of fat, which may occur in people who live in a very frugal way; but exercise is always to the good. The setting in of obesity is often associated with the waning of reproductive functions.

P is for PHTHISIS or CONSUMPTION, the disease set up in the lungs in particular when the tubercle bacillus establishes itself there and breaks down the tissues. To some extent it has been conquered, for much can be done in the way of preventing multiple infection and in helping the not too heavily infected patient to conquer the intruder. A curative anti-tubercle treatment has been often announced and is sure to be established some day.

Q is for QUININE, a bitter extract of the bark of the Cinchona tree, well known as one of the surest of medicines, being antagonistic to the development of such microbes as the malaria organism. It seems to make the blood more resistant to their multiplication, if they should be introduced by the bite of the mosquito.

R is for RICKETS, a common disease of children, marked, for instance, by the defective development of the bones. It is one of the "deficiency diseases"

now known to be due to a lack of certain vitamins in the food. It can be counteracted by cod-liver oil and by orange-juice; by sunlight; or by an adequate supply of natural foods like milk.

R might also stand for Radio-therapy.

S is for Sleeping Sickness which is brought about when the Tse-tse fly (*Glossina palpalis*) infects man with certain microscopic Protozoa known as Trypanosomes. These live normally in the blood of some wild animals of Tropical Africa, such as antelopes, but they run riot when introduced into a new host like man who has no natural defences to cope with their multiplication. They destroy the red blood corpuscles, and infection is apt to be fatal. Yet to some extent they have been conquered, since the vehicle of their introduction into man is known, and it is possible to do something to avoid being bitten by Tse-tses.

T is for Thyroid Treatment, by which cretinoid arrest of development in children and diseases like myxœdema can be successfully counteracted, the deficiency in the patient being supplied by the active principle (thyroxin) introduced in preparations of the thyroid glands of sheep and calf. Thyroxin was isolated by Kendall, and has been artificially synthesised by Harington and Barger.

U is for the Unification or Integration of the body which is essential to really good health. It means a harmonious orchestration of the various everyday functions, and this is mainly effected by the nervous system and by the blood. It is so important that we have given it a special section by itself, entitled, *"How the body is made one."*

V is for Vitamins, accessory food-substances which are necessary for health. In minute quantity they are present in many common natural foods such as milk and fruit, green vegetables and potatoes, but they are usually destroyed by boiling. When there is nothing but preserved food, sailors get scurvy; but this may be kept off by having a store of lemons.

V might also stand for Venereal Diseases, which have been in great part *theoretically* conquered.

W is for the Web of Life—a convenient phrase for summing up the inter-relations or linkages that bind living creatures together. The further conquest of disease depends in no small measure on a recognition of this Web of Life. Thus Malaria has to do with mosquitoes, and these, it may be, with little fishes; Sleeping Sickness has to do with Tsetse flies, and these, it may be, with antelopes; Guinea-worms have water-fleas as their vehicle and

Bilharzias are wrapped up in the bundle of life with water-snails.

X is for the X-CHROMOSOME or accessory chromosome, a special nuclear rod in some germ-cells which is associated with the determination of sex. Thus in some insects all the egg-cells have an X-chromosome, but only half of the sperms have it. When an egg-cell is fertilised by a sperm-cell with an X-chromosome, it develops into a female. When an egg-cell is fertilised by a sperm-cell without an X-chromosome, it develops into a male.

X might also stand for X-RAYS.

Y is for YELLOW FEVER which is due to a microbe disseminated by one of the mosquitoes. In places where "Yellow Jack" used to levy a terrible toll year after year, it is now relatively rare, and this has been effected, as in the parallel case of malaria, by removing or filming with oil the stagnant pools where the larval mosquitoes live.

Z is for ZOOLOGY by aid of which it has been possible to unravel the life-history of so many parasites and to understand so many linkages which bind living creatures together in the web of life. Had Major Leiper not been a student of Zoology, who mastered the story of the Liver-fluke, he would not

have cleared up the life-history of Bilharzia and saved thousands of lives.

§ 8. The Living Creature on its Defence

Many a mineral has great capacity for endurance. It is not quickly weathered; it has a high degree of chemical inertia. But the slowly changing block of granite does not do anything, and thus it is not comparable in its endurance even to a midge, whose marvel is that it keeps agoing in spite of expending much energy for its size, and being the seat of intensely rapid, sometimes almost explosive, chemical changes. As a matter of fact, it does not keep up its midgy activity for very long; yet this ephemeral insect is in its way true to the symbol of life—the Burning Bush—aflame yet not consumed.

If one could clearly understand how the living creature is able to repair or recuperate itself as quickly as it wastes or wears, and how it continues doing so for days or months, for years or cycles of years, one would have broken down the outermost rampart of the citadel of life, so long beleaguered by the hosts of science. There are hints, however, that the wall is beginning to give way. It is cer-

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tain, for instance, that vital phenomena depend in a great part on ferments, whose peculiarity it is that they can do a great deal of chemical work very rapidly without exhausting themselves. It is also certain that part of the virtue of protoplasm—the physical basis of life—lies in its being colloidal—a state of matter in which very minute particles are held in a fine state of dispersion in a fluid. They expose a large surface to the action of ferments and other reagents; they are in a very dynamic phase, even when they pass from the "sol" state into a "gel."

A third feature is that living creatures have a unique power of accumulating potential energy in the form of complex carbon-compounds; and this helps them to act very rapidly on the defensive. They have stores and reserves—in a word, capital. When we add to the ferments, the colloidal properties, and the accumulation of energy, the more vital quality of being able, at many different levels, to enregister experience, so that living creatures give specific answers to different kinds of stimuli, we are in a better position to inquire into their powers of persistence in a world which, though not always unfriendly, is certainly callous.

The relations between organism and environment

are manifold. Thus the living creature may utilise its surroundings, as the green leaf uses a fraction of the sunlight that bathes it, or as we use the oxygen of the air in breathing. Or it may act more strenuously on its circumstances—shifting them about, boring into them, undermining them—even devouring them. This is the organismal thrust. Or again, when environing conditions are difficult, the organism may evade them, as the migratory birds and the hibernating mammals evade the winter. Once more the living creature may individually develop, or racially evolve, some protection, it may be a thick skin or polished armour, from which the arrows of outrageous fortune glint off, doing no harm. This is the organismal parry.

But there is an even more intimate kind of reaction—what the organism does when the enemy is not at the gates but within the walls, when there is fighting in the streets. Let us illustrate these internal defences. An animal is wounded and the blood begins to flow. If that continues long, the creature will die; a fatal hemorrhage, we say. But what often happens, if the wound be not too large or deep, is that the blood clots and the loss ceases. It is the commonest possible life-preserving reaction, but how difficult to explain—how a complex

called thrombin, which was not there before, changes the protein "sol" of the blood into a firm "gel" of fibrin, an organic sticking-plaster over the cut!

Of great importance are the reactions which save many organisms from the dangers of extreme heat and cold. In lower forms of life there is often a relapse into deep inactivity which is self-preservative; the fire of life burns very low, one can hardly say more than that it is "not out." The vital fermentations cease for a time, and the protoplasmic molecules are saved from disintegration by lying low. A goatmoth caterpillar may be so gripped by the cold that it breaks across in our fingers, yet the anterior end at least will move about again when slowly warmed. In birds and mammals, as every one knows, there are delicate adjustments which keep a balance between the production and the loss of body heat, and we do not know which most to admire—the ordinary heat-regulating arrangements which secure for birds and ordinary mammals a practically constant temperature, day and night, year in and year out, or the exceptional conditions illustrated by the imperfectly warm-blooded hibernators. In most cases it may be said that the defences against extreme variations of temperature

depend fundamentally on the protoplasmic fermentations.

One often sees a goat or some other animal eating a poisonous plant, and though fatal mistakes are sometimes made, the big fact is that living creatures can become accustomed to almost anything. We see the snail enjoying a poisonous fungus, and while from the horticultural point of view we hope the meal may be fatal, we know that nothing happens. There are people in the Tyrol who are quite healthy, though they use arsenical preparations that would kill any of us the very first time. The Oriental who visited De Quincey and put into his mouth a piece of poison that made even the Opium-eater stare, was never found dead! The word poison is relative; what is one organism's poison is another's food. One fancies that the goat or the donkey is like Mithridates, King of Pontus, who was so habituated to poisons from his youth up that he became immune to all! In any case, the living creature has astonishing powers of adjusting itself to, and of counteracting frequently recurrent poisons.

The severest test to which an organism can be put is a serious infection, for that means that living enemies have gained entrance into the fortress.

Sometimes the activity of the invaders is strictly localised, and they dissolve away cellular material at some particular spot till a breakage or lesion results; sometimes they produce a toxic secretion which has a poisoning effect far and wide throughout the body; sometimes there is both a local and a general disturbance. The business is, of course, very subtle, but it means fundamentally that the colloidal equilibrium in the living units of the body is disturbed, it may be fatally, by what the intruders produce.

The first defensive reaction of the invaded animal is the production of an antitoxin which counteracts the toxic influence of the microbes. Roux and Yersin discovered the toxins of microbes; Behring and Kitasato proved the reality of anti-toxins; Roux and Martin showed how anti-toxins produced in one organism may be introduced into another that has been infected by microbes, and has not been able to produce counteractives of its own quickly enough or abundantly enough to secure the defeat of the invaders. It should be noted that anti-toxins have not as yet been isolated, and they need not necessarily be definite chemical substances. They may be properties of colloidal equilibrium. But there is no doubt as to their efficacy.

The second great defence is by no means of phagocytes—a discovery mainly due to the genius of Metchnikoff. From sponges to man, with a few exceptions, the organism has a bodyguard of mobile amœboid cells which are able to engulf and digest intruding microbes. In backboned animals the phagocytes are specialised white blood corpuscles, slightly different from their neighbours. In some cases it seems that the invaders cannot be engulfed and digested unless they have been previously weakened by an opsonin in the blood, which may be the anti-toxin already referred to.

The defensive values of antitoxins and phagocytes are generally recognised, but the same cannot be said of d'Herelle's interesting theory of "Bacteriophages." These are ultra-microscopic microbes, normally present in the body, the deadly enemies of intrusive disease causing bacteria. They are supposed to form secretions of great opsonic potency which educate the phagocytes and dissolve the bacteria. According to d'Herelle, they are our unrecognised guests or partners that help us towards innate immunity, though by no virtue of our own. But we hear the sound of the whetting of William of Occam's razor, *Entia non sunt multiplicanda præter necessitatem.*

§ 9. How the Body is Made One

Very characteristic of health is the feeling of unity and harmony, so it is of importance to consider on what it depends. It is technically called integration, whereas disease always implies some degree of disintegration.

A large sponge, as big as one's head, is like a busy city of cells. It has an extraordinary complex Venice-like system of incoming and outgoing canals; it has a manifold diversity of beautiful spicules that make up its skeleton, and, in the case of the bath sponge, there is an extraordinary tangle of silky spongy fibres that has played no unimportant part in civilisation. The cells of the sponge-city are incomputably numerous, and include many different types, such as those whose ceaseless lashing keeps up the currents in the canals. Yet a big slice may be cut off this sponge without making any appreciable difference; the sponge is not a unity, nor can it act as one.

A cut-off fragment of a sponge will soon grow into a whole, and drops of a piece of sponge that has been put through a mincer may reconstruct the whole. What a sponge lacks is integration; like

modern society, it is inadequately unified into a controlled whole. And one reason why sponges have not got on, but remain in a blind alley of evolution, is that they have no nerve-cells. Without these a large body cannot be made one.

Every one knows the beautiful sea-anemones that nestle like chrysanthemums, sometimes like daisies, in the niches of the seashore pools. When you touch the tentacles with your little finger, they all contract inwards, and this reaction is in normal circumstances very useful in securing booty, such as a small worm. Moreover, in some cases a sea-anemone shifts its moorings from a place of dissatisfaction to a place of promise; and this implies acting as a unity. All over the surface of the body of the sea-anemone there is a network of nerve-cells and nerve-fibres. Yet the unity of the sea-anemone is very limited.

If the tentacles on one side of the circum-oral wreath be cheated with faked food, such as blotting-paper dipped in weak beef-extract, they soon learn to reject this without more ado. But the suggestive fact is that if the tentacles on the other side of the educated sea-anemone's crown are then tempted with the same delusive bait, they accept it. This

means that the lesson learned by one half of the tentacles cannot be passed over to the tentacles of the other side.

What is it that the sea-anemone lacks? The answer is—a central nervous system. It is like a country without a government. Unlike the sponge it has plenty of nerve-cells, but they are not centralised. It might be compared to a community with many able and clever men who never meet to take counsel with one another. Above all else, it is the central nervous system that makes a complex body one.

In every animal with a central nervous system—from earthworm to elephant, from bee to bird—there are multitudinous reflex actions. As we have already explained, the sensory nerve-cells (or scout-cells), with their far-penetrating and readily thrillable tendrills, collect information and receive news from the outer world and from the recesses of the body. The stimuli pass to associative, communicating, or, as we may say, General Headquarters cells. Thence subtly transformed, the tidings pass to the motor nerve-cells (like executive officers), which send out orders to muscles and glands (the rank and file) where work is done or things are made.

Many of these reflex actions may take place individually without any help from the brain, but the important fact is that the possession of a central nervous system (brain and other ganglia) makes it possible to unify the multiplicity of acts into coherent behaviour. The better and the clearer the brain the more is the body made one.

But, besides the physiological integration by means of the visible and tangible nervous system, there is in the higher reaches of life a psychological integration. The two aspects may be inseparable, but they are distinguishable. A mother-animal may be so moved with parental affection that she gives her life in defence of her offspring. A dog may set off on a journey with a purpose, and even if it is only a perceived purpose, no more than a mental picture of something desired, it is on the psychical, not on the physical side. Affection and purpose are imponderables; and there are few open-air naturalists who hold by a natural history that altogether leaves out a consideration of *esprit de corps*.

We have just spoken of the integrating function of the nervous system and the mind, but at a distance from that there is the physical unification of the body by the interweaving of strands of connective tissue, by the binding together of the mus-

cles, and by the coherent skeleton. Perhaps this is not thought of quite enough. It makes for unification when many parts of the body, muscles especially, are attached to a coherent skeleton like the shell of a crab or cockle, or the carapace of a tortoise. When we speak of a man having too little backbone, we are not actually referring to his vertebral column; and yet it is true that the backbone helps to make the body one.

It is impossible to exaggerate the importance of the evolutionary step implied in the establishment of an effective blood circulation. As food-carrier, oxygen-carrier, waste-carrier, and in other ways, the blood makes the body one. The heart is at the heart of life. The blood is the complex common medium from which all the cells of the body take, and to which they all give. With the help of the lymph, which bathes the tissues most intimately, the blood-vessels have a profoundly important integrative function, and since vivid visualising influences behaviour, it would make toward better health if more people had a lively picture of the circulation of the blood! But the importance of this has been greatly enhanced during the present century by the discovery of the unifying and harmonising rôle of

the chemical messengers or hormones which are manufactured by the ductless glands and pass into the blood to be distributed throughout the body, now exciting and again moderating, but always acting like magic for good and ill. To sum up this paragraph, the body is integrated (*a*) by the nervous system, and in higher animals, (*b*) by mental unification as well, (*c*) by the common medium of the blood and the lymph, (*d*) by the specific messengers or hormones, and (*e*) to some extent by the possession of a coherent scaffolding, the skeleton in particular.

CHAPTER II

SURROUNDINGS, FOOD, AND OCCUPATIONS

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CHAPTER II

SURROUNDINGS, FOOD, AND OCCUPATIONS

The relations between our health and our environment or surroundings are hundred-fold, for, apart from our mental and social milieu, the biological environment includes the soil, the amount of sunlight, the freshness of the air, the humidity, the winds that blow, the height above sea-level, the conditions of the house as regard space, lighting, ventilation, and so forth. To consider all these inter-relations is by no means the intention of this chapter; all that we wish to do is to illustrate the biological principles that are involved.

§ 1. Sphere within Sphere

The whole outer world apart from life and man may be conveniently called the Cosmosphere,—including sun, moon, and stars, the air we breathe, the earth on which we tread, and all the seven seas. As every one knows, it has its subdivisions, such as

atmosphere, hydrosphere, and geosphere, each with its important influence on our health.

Within this cosmosphere and inter-penetrated by it there is the world of life—the BIOSPHERE, including all the plants and all the animals, besides other living creatures like bacteria which can hardly be called the one or the other. All these living creatures or organisms are chemically and physically built up of the materials and energies of the cosmosphere, so far like the eddies or whirlpools on a river, but each has its individuality and some power of effective action and reaction, of which one sees but little in the domain of non-living things. Yet we must not be too quick to exaggerate these real differences into absolute distinctions, for some whirlpools have considerable individuality and some carve out pot-holes in the hard bed of the river. In any case it is an important biological fact that streams of matter and energy are continually passing into and out of the living creature, and that dying is in natural conditions followed by a return of the incarnated materials and energies to the cosmosphere which we call inanimate. The circulation of matter is a large fact. As the Greek philosopher said: "All things flow."

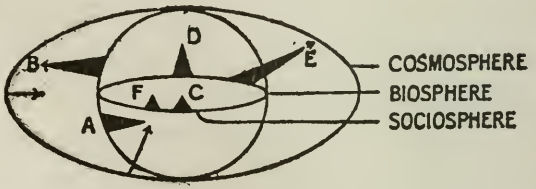
But within the biosphere there is the kingdom of

Man—the SOCIOSPHERE, including all peoples and all their permanent products.

It is obvious that the cosmosphere acts on the biosphere and the sociosphere, the biosphere on the sociosphere and the cosmosphere, the sociosphere on the biosphere and the cosmosphere; but it is interesting to notice how the cosmosphere may sometimes go far towards re-capturing the living creature, as in some calcareous seaweeds and very stony corals, where life is at a very low ebb; or how the biosphere may sometimes go far towards re-capturing the human being, as in habits that brutalise and surroundings that disintegrate.

On the other hand, it not unprofitable to notice that organisms may capture part of the cosmosphere and turn it to their own purposes, as when beavers make a dam, or white ants build the earth into a huge edifice often rising above a man's height. Similarly, man conquers part of the cosmosphere in all his geotechnic operations, as when he changes the course of a river or reclaims land from the salt marsh. "There where the long street roars there slept the silence of the central sea." That man has often mastered part of the biosphere is picturesquely illustrated by the successes of his domestications and cultivations.

We are not concerned in this book with the amount of cubic space which every inmate of a house should have, or with any detailed fact of this sort; important though all of them are, we have to do with general principles and our point is that an appreciation of the relation between our health and our environment requires some appreciation of the manifold—and subtle—influences that may be involved. A general diagram may be useful.



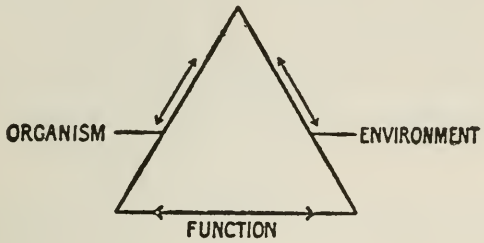
The cosmosphere surrounds the biosphere which in turn includes the sociosphere.

A. An influence on the biosphere from the cosmosphere.
B. An influence from the biosphere on the cosmosphere.
C. An influence on the sociosphere from the biosphere.
D. An influence from the sociosphere on the biosphere.
E. An influence on the cosmosphere from the sociosphere.
F. An influence on the sociosphere from the cosmosphere.

§ 2. The Biological Prism

Those students of human society who think of their problems concretely, not abstractly, are accustomed to consider everything in terms of Folk, Work, and Place (Leplay's Famille, Travail, Lieu). A moment's thought will show that these

are the same as the biologists' Organisms, Function, and Environment, in other words the living creatures themselves, their activities and their surroundings. Everything vital must be thought of in these three aspects—the three sides of the prism



The mutual relations between organism and environment, with a suggestion of the extending scope and influence of organism, function, and environment.

which biology must use in seeking to analyse the light of life. They illustrate what may be legitimate abstractions. They are necessary although it is quite true that a living creature soon ceases to be living if it is taken out of its essential and appropriate surroundings—"a fish out of water," as we say. Similarly with function, it would be pedantic not to discuss it separately although it plainly consists very largely of action and reaction between organism and environment. It might be thought that the environment of organisms was something independent and by itself, yet we see that this is not

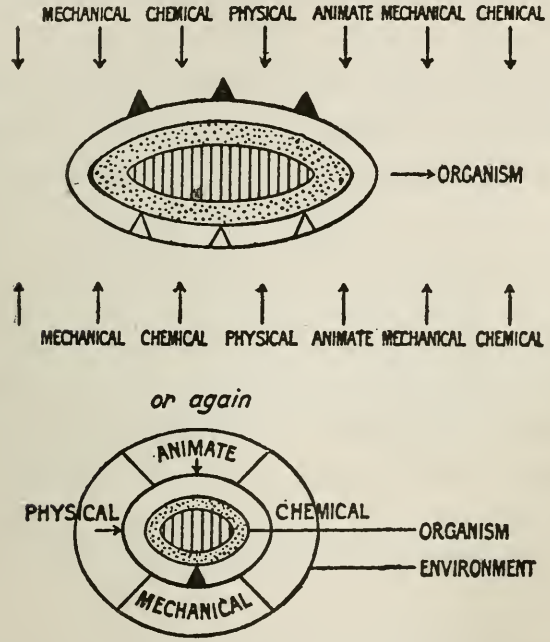
the case whenever we recall the commonplace that green plants make and have made the oxygen which animals require for breathing. For many a living creature it is true that a very important part of its environment is made up of other living creatures, for it is usual in biology to include the food as part of the "environment." A diagram of a cross-section of the "biological prism" may be useful (see preceding page).

§ 3. Analysis of the Environment

The factors in the environment of living creatures may be conveniently grouped as (1) *mechanical,* such as pressures and currents, gravity and amount of space; (2) *chemical,* such as the composition of the air, the water, and the soil; and here also it is usual to include the food; (3) *physical,* including especially heat, light, and electricity; and (4) *animate,* including other organisms in so far as they are directly influential, as in the case of parasitism or partnerships, of encrustations or crowding neighbours. Booty and enemies might also be considered here, but their main influence is indirect, through function.

This may be expressed diagrammatically, the

arrows indicating the factors, the elevations and indents indicating the modifications induced on the organism's body, respectively of a stimulating and depressing character. The organism, which



The organism with its layers, tissues, and organs, is imagined to be passing under the influence of the mechanical, chemical, physical, and animate factors of the environment, which evoke changes in it and provoke reactions.

may be ourself, must be thought of as moving slowly through an ever changing series of these environmental factors, which are most influential during the plastic period of youth, yet are most

apt to bring out depressant changes during the period when strength begins to wane. For a moment, since the metaphor is too one-sided, we may think of the organism passing over a succession of anvils on which diverse environmental hammers play.

The zones inside the part of the diagram which represents the organism are inserted to suggest another point, that the various modifying influences, whether stimulants or depressants, operate on different systems of the body—nervous, sensory, muscular, integumentary, alimentary, and so forth, —some touching health more to the quick than others. A browning of the skin in the sunshine may be of little importance in itself, but it may render the body in some way more amenable to the tonic influence of ultra-violet rays, when the atmosphere is clear enough to allow of their abundant presence.

§ 4. Two Aspects of Life

That kind of activity which is called "living" has been briefly described as "effective response," for the self-preservative answer-back that the organism makes to its surroundings is obviously very different from the suicidal response that the barrel

of gunpowder makes to a spark. But the term "effective response" lays all the emphasis on the answer-back, whereas the able-bodied organism very frequently acts spontaneously on its environment as well as being prompted to reaction. In fact, as Professor Patrick Geddes has clearly pointed out, there are these two distinct aspects of life: at one time Organism (which we may spell with a capital) acts on its environment,

$$O \rightarrow f \rightarrow e$$

(Organism functions on its environment);

as an insurgent animal in good health very frequently does; but at another time the Environment (which we may now spell with a capital) acts on the organism,

$$E \rightarrow f \rightarrow o.$$

(Environment evokes functions in organisms).

It is a clarifying idea that living may be described, not defined, as an ever-changing emphasis on the $O \rightarrow f \rightarrow e$ aspect, or on the $E \rightarrow f \rightarrow o$ aspect. This may be expressed in the ratio:

$$\frac{Ofe}{Efo},$$

the proportions of numerator and denominator

varying from day to day, from type to type. Thus plants do not act on their environment so insurgently as typical animals do; and a sponge is as much in the grip of its environment as a Storm Petrel is emancipated. Fatalistic peoples are those to whom the denominator of the fraction seems a much larger fact of life than the numerator. They feel themselves in the grip of the sea, the desert, the long dark winter, or whatever the dominant external Fate may be. To buoyant masterful peoples, on the other hand, the large fact of life, which chimes with their temperament, is man's growing conquest of his kingdom. Man is man and master of his fate. *In health the numerator is clamant; in subhealth the denominator commands.*

The descriptive formula of living, $\frac{Ofe}{Efo}$, is obviously not a definition, since it includes the term "organism" or living creature, which is what has to be defined. Moreover, the undeniably useful and suggestive formula, to biologist and sociologist alike, does not do justice to the fact that many of the transformations of matter and energy that go on in the body are neither actions on the environment, nor direct reactions to it except in the sense that all living implies oxidation. The living creature cannot

create any energy; it is only a transformer. What we call spontaneity in action is dependent on previous enregistrations and storages, though it may be by the "free mind" that the particular occasion for activity is determined. But our point is simply that functioning is in no small measure a kind of internal activity, as in the beating heart, the digestive stomach, the filtering kidneys, which must go on if the organism is to continue as an effective integrated agency. The living creature is much more than an engine or collocation of engines, but the metaphor may be permitted to make clear this point that the engines of the body must be kept running even when no external work is being done. The problems of individual health in their broad biological aspects are concerned with (*a*) the organism's efficiency in acting on its environment; (*b*) the organism's efficiency in responding or reacting to environmental stimulation and in receiving contributions from the environment such as food and oxygen; (*c*) the organism's efficiency as regards those internal sustentative functions which keep it in a fit state for (*a*) and (*b*), or, in other words, which maintain it as a smoothly-working going concern; and (*d*) the organism's effective control of the reproductive or sex-functions.

§ 5. Folk, Work, Place

Translating the biological formula

$$\frac{O-f-e}{E-f-o}$$

into sociological terms, as Professor Geddes does, we must read

Folk → work → place
(Organisms → function → environment)

as one of the two main aspects of human social activity, verifiable also in the ant-hill and the bee-hive or any other animal social integrate. The other aspect is

Place → work → folk,
(Environment acting on organism)

where the surroundings influence the occupations and these the people who work. Thus the two aspects are combinable in the ratio, exactly analogous to $\frac{Ofe}{Efo}$, namely,

$$\frac{F \rightarrow w \rightarrow pl}{Pl \rightarrow w \rightarrow f},$$

a very useful formula for those who would think in a broad yet precise way of such problems as those of social hygiene.

The formula can be used to express, even to suggest, steps of progress. A change in the mental outlook of a people may effect great ameliorations in the environment, and these again may react on the character of the people. Thus *F, w, pl* becomes *F′, w′, pl′*, and this may be followed by $Pl'—w^2—f^2$. Or, as in the case of changes of climate, so significant in human history, the initiatory impulse towards change, for better or for worse, may come from the environment. Thus a period of aridity may induce migration, and a period of material prosperity may bring about great increase in the population and aggressive war.

As with the biological formula, *Ofe: Efo,* so with the sociological *Fwpl : Plwf,* it must be noticed that there is in a human societary form much activity that is concerned with the internal regulation of the body politic, and is not in any strict sense either working on the place or being worked upon by it.

§ 6. The Power of the Environment

All are agreed that no amount of environmental amelioration can change tares into wheat, yet scientific experiment corroborates the conclusion of common sense that the character of the crop depends on the soil, the sunshine, and the showers, as well as on

the seed. We must be careful not to under-estimate the influence of the environment in the widest sense in determining the degree of expression to which the individual attains in development. One may not be able to make a silk purse out of a sow's ear, but "nurture" can work wonders in corroborating the individual's good "nature." Whether this has any specific or representative effect on the next generation is an undecided question. Let us recall some of the vivid instances of environmental influence.

Goldfishes kept in complete darkness, but in otherwise wholesome conditions, for three years become quite blind, and there is a degeneration of the retina.

The pale newt called Proteus, which lives in the darkness of the Dalmatian caves, has eyes which are arrested in the course of their development, and never reach the skin. But if the wan creature is kept in a well-lighted room, it puts on skin pigment before a fortnight is past; and if the young stages are reared under red light in a laboratory, the eye continues its development, increases beyond its ordinary size, reaches the skin, and becomes an organ of vision. In the light the animal regains its sight.

Young peach-trees transported to Réunion be-

came evergreens, though it took some of them twenty years. The seeds of some of them that were sown in mountainous regions with some frost grew up into evergreens.

When the red variety of the often cultivated primrose, *Primula sinensis,* is reared at 15°-20° C., it has red flowers; but if similar plants are reared at 30°-35° C. in a moist and shaded greenhouse, the flowers are white. The ordinary white variety, *Primula sinensis alba,* has white flowers whatever be the temperature.

When the simple worm called Planaria is fed on the minced flesh of the freshwater mussel, a kind of food which it does not relish, its growth is slowed down and its vitality is lessened, as is shown by diminished resistance to poisons. It becomes gradually old, and after several generations of asexual reproduction the individuals are "born old." No one would dream of hastily arguing from worms to man, but one gets a hint of the dietic dangers of too much porridge on the one hand, or too much partridge ("toujours perdrix") on the other!

§ 7. The Air we Breathe

This is a long story, but we are concerned here with the fundamental facts only. It was one of

the great steps in the history of science when Lavoisier placed the living animal beside the burning candle, and made it for the first time clear that all living implies oxidation or combustion. The powers we have of doing things are for the most part traceable to the energy liberated when our food is burned as fuel within our body. Although the contraction of a muscle is primarily a physical event, like the releasing of a spring, rather than a chemical process, it cannot go on without the oxidation of carbon compounds. Except in a few strange (anærobic) organisms which are able to obtain oxygen indirectly, all living creatures require free oxygen if they are to continue alive. Green plants during the day are able to produce oxygen by splitting up carbon-dioxide, but during the night they require free oxygen from the atmospheric air, or from the air entangled in water. Similarly all but a few exceptional animals obtain oxygen from the air or from the air entangled in the water or in loose soil. It is generally believed that the greater part of oxygen in the atmosphere has been produced by the action of green plants.

In ordinary atmospheres there is about 21 per cent. of oxygen and this is rarely lessened by as much as 1 per cent. And here must be noted the

important fact that while there is seldom any marked deficiency of oxygen, a slight deficiency makes a great difference in the work that a higher animal has to do in order to keep up the normal supply in its blood. The blood has to be sent round oftener to the lungs where it captures oxygen and loses the waste carbon-dioxide; this gives the heart more work to do and the result is fatigue. The lungs have to be filled and emptied more frequently, and the result is fatigue.

Similarly, as regards the carbon-dioxide in the air, the differences that count are small. The normal percentage is about 0.03; and in the stuffiest rooms the percentage never exceeds 1, and is rarely as much as 0.5. The excess cannot enter our blood, else we should immediately die; what makes us tired and depressed is the extra exertion of over-breathing, which is increased when the air is warm and damp as well as impure.

There seems no scientific basis for the widespread belief that noxious organic poisons lurk in the air of stuffy buildings. There is nothing of this sort worth talking about, except of course the floating germs of disease, and these are bad enough without having inventions tacked to their tails! Similarly, while smells are unpleasant, and may be psycho-

logically depressing, they do not seem to be of much physiological importance except in so far as they are indications of the abundant presence of bacteria.

Of extreme importance is the quantity of dust in the air, for this means that much of the light is lost, including most of the ultra-violet rays. Light is a tonic to life; it also kills off floating microbes; its reduction is very expensive in scores of ways. Dust particles afford the surfaces on which water vapour condenses, thus forming fog, which is very costly both physiologically and economically.

During a foggy period between 24 January and 7 February, 1880, the death-rate in London is said to have risen from 27 to 48! "Muggy" weather, which implies cold humid air, involves a great loss of physical energy in the work of breathing.

It is always worth while watching the path of a beam of light through a darkened living-room, for it reveals the multitudinousness of the finer dust particles which are borne hither and thither by draughts and differences of temperature. As a matter of fact we do not actually *see* the motes, for they are invisible; we see the light reflected from their surfaces, forming a kind of halo much larger than the actual motes. Besides the finer particles which may be bacteria and pollen grains, minute

egg-cells and spores, infinitesimal fragments of hair, skin, and clothes, there is coarser dust consisting of soot, mineral particles, manure fragments and so forth. Different kinds of dust differ in their evil effects; thus free silica dust makes the lungs more susceptible to the microbes of tuberculosis, and pollen grains of grasses and the like may set up hay fever; but for our present purpose it is enough to say that dust and death go hand in hand.

The biology of ventilation has its foundation in the fact that the air must be kept moving. The movement of the air works in several different ways: (1) It prevents the accumulation of microbes (thus cutting both ways, for it spreads them about); (2) it promotes evaporation from the skin, and this keeps the body-temperature from stagnancy; and (3) for some reason not at present very clear the activity of the air helps breathing. The experiments of Professor Leonard Hill have shown that the breathability of poor air is greatly improved if it is coerced into movement by an electric fan or the like.

So many people live in sub-health that wholesale advice is impossible, but the general principle is sound, that free evaporation from the skin should be encouraged. It is favourable to the absorption of

the food, the activity of the kidneys, the pitch of cheerfulness, and fitness generally. When the circulation is good, and the feet are warm, it is always useful to throw up the window and let in cool fresh air. But to people who do not react to this normally, the draught may be as fatal as a plunge into cold water.

In regard to the dissemination of disease-germs by air-currents, it should be noted that infection from the air is much less frequent than used to be supposed. Infection is oftenest from person to person by contact, coughing, spitting, and the like, or by means of solid food, milk, and contaminated water. Microbes do not live long in sunlit air.

§ 8. Hygienic Value of Light

Modern science has written a long commentary on the text: More light, more life; and there is still much to be discovered.

(*a*) It is light that makes possible the most important process in the whole world, the green plant's upbuilding of food-stuffs out of air and soil-water.

(*b*) We have already referred to the therapeutic value of sunlight in killing microbes in the air and

it is also able in some measure to sterilise water. An intensifying of this therapeutic power can be utilised in the cure of certain diseases.

(*c*) Light has a tonic influence on healthy animals, stimulating the metabolism, as we see and feel in the quickened pulse. In moderation, light acts as a stimulant to animal growth and development, and sunbaths are now being effectively utilised for the invigoration of the young victims of the darkness of our large cities.

(*d*) Besides physiological stimulation there is a psychological effect. "The light is sweet to the eyes." "It is no small thing to have lived in the sun." It is not for nothing that light is always used as the symbol of the supreme blessings—"the light of the eyes," "the light of the mind," "the light that lighteth every man that cometh into the world."

Special importance attaches to the ultra-violet rays, which first produce sunburning, and then, through that protective screen, a valuable tonic influence. Animals like lizards at the Zoo which used to die in winter are now able to survive and in great vigour. Unlike the X-rays which penetrate deeply, the ultra-violet rays have a shallow influence, yet it may be life-saving. They are reduced by absorp-

tion in dusty air and are thus much more abundant on mountains than in manufacturing towns. There are more in the sunshine of the Côte d'Azur than on a dusty plain. They are stopped by ordinary glass, so they cannot enter a house with shut windows. A small volume might already be written on the value of the ultra-violet rays, which we cannot see, though the ants do, but all that we are concerned with here is the general proposition: The more light, the more life. To walk and work in darkness is to invite disease.

§ 9. Warmth

More people suffer from over-heating than from over-cooling. In close rooms, with big fires or over-high central heating, there is apt to be an abnormal rise in the temperature of the blood, aggravated, of course, if the body is too thickly padded with heavy clothing. The over-warmed blood passing through the heat regulating (thermotaxic) centre of the brain, stimulates the nerve-cells to issue orders to the sweat-glands of the skin so that perspiration is increased. As this evaporates, there is cooling down and normal temperature is restored. But if the sweat-glands are not working well, or if the

surrounding air is moist, so that evaporation is checked, or if the clothing is too thick and heavy, then the alternative is that more blood must be driven through the skin so as to bring about the requisite cooling. This extra work puts a strain on the heart. Moreover, the driving of the blood in ever-increasing volume through the skin means that there is less available for other parts—such as the brain, the viscera, and the muscles. These begin to lack oxygen and food, and the heart has double work to do. If the heart succeeds in sending the blood round more rapidly than usual, then it is apt to be tired by the extra-exertion; yet if it does not succeed there is bound to be oppression and depression. Children become listless; adults become bored and irritable; there may be headache or faintness—all because of a condition of heat-stagnation in the body. The fundamental rule is to keep up free evaporation.

It is very important to have a vivid picture of the rôle of the skin, which loses heat by radiation and is also cooled as the water of the sweat is evaporated. The evaporation has a far-reaching influence on the hardness of the body, the absorption of food, the filtering by the kidneys, the process of respiration. Sweating over one's work—even the

sweat of the brow—makes for clear-headedness. Health implies a circulation of warmth, and while we have been laying emphasis on the dangers of over-heating, corresponding difficulties may be brought about by over-chilling, which also reduces the normal conductivity, for instance by the constriction of the small blood-vessels in the skin. To this constriction the pallor of cold is due, while the "pinched look" is brought about by the contraction of muscle-fibres in the under-skin or dermis, —a contraction which also reduces the evaporating surface.

All this has an obvious application to clothing, of which most of the inhabitants of northern countries tend to wear too much. Professor Leonard Hill tells of the disrobing of a curate, who, on a mild winter day, was wearing a thick llama wool vest, a thick woollen shirt, a wool-lined waistcoat, a cardigan jacket, a tweed suit, and a wool-lined motor coat. He was probably feeling the cold, and it is plain that this common overquilting must work deleteriously in various ways. It may cause over-sweating and yet prevent free evaporation; it tends to produce a hothouse "internal climate" in contrast to the external climate to which the only surfaces exposed are the face and the lungs. Dar-

win tells of his surprise at seeing women and children living in severe cold with no garment save an otter's skin. The kilt may not suit us all, but it is a highly hygienic dress, and makes a good diagrammatic contrast with more conventional clothing which has not only far too many layers, but is worn far too tightly.

Health implies a balance between the heat produced and the heat lost, and the heat of the body, lost on the skin, comes in the long run from the fuel or food. The fundamental chemical routine or metabolism of the body is in proportion to the surface of the skin. On an average a full-grown man requires forty calories per square metre of skin, a calory being the amount of heat in the food that will raise a pound weight a foot in the air. It is an important piece of biological statistics, that while a grown man requires forty calories per square metre of skin, a growing boy requires forty-four. Big men need more food than small men; and cold winds demand an increase in calories. The mistake is often made of trying by clothing and by reduced ventilation to lessen the loss of heat from the skin, but this works in the wrong way. What is desirable is to keep up the *circulation of heat.* Hence the need of exercise in cool open air, for

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heat is lost in a pleasant easy way; the loss is readily compensated for by increased heat-production; and thus stagnancy of body-heat is avoided. The exercise helps to get rid of nitrogenous waste; it keeps fat from accumulating; far more than gymnastics, pleasant exercise means a tonic effect on the general metabolism. A distinguished authority points out that "even sitting out of doors in winter is sufficient to increase heat production, and keep the chemical processes of the body working at a high level." The most important general idea in this connection is to keep the warmth of the body going round. It is truer than the widespread economic belief that the main thing is to keep money circulating.

§ 10. Influence of Food

Advice in regard to diet is not within our scope; we may refer to the convenient book by Professor and Mrs. Plimmer. All that we aim at is to indicate a few general ideas. Food is required (*a*) for growth, (*b*) for fuel which is directly or indirectly expended in the work done by the body, (*c*) to sustain the heat of the body which is lost in the expired air, in the waste-products, in the evaporation from

the lungs and from the skin, and in the superficial radiation. Food is also needed (*d*) to make good the wear and tear of tissues.

An obvious general principle is that the food taken in must balance the expenditure of energy indicated by the waste-products and the heat lost. The tendency of civilised man is to take far too much food, so that the body is as much taxed with dealing with the surplus income as with doing its daily work. The value of the food is usually measured in calories. A large Calory (with a capital) is the amount of heat required to raise a kilogramme of water from 15° to 16° Centigrade, and a small calory (without a capital) is one-thousandth part of this. Now a full-grown man of sedentary habits requires every day such food as will yield 2500 calories. In cases of severe muscular work 4000 calories may be required. The different kinds of food vary markedly in their heat-yielding power (calorimetric value). Thus a gram (or $\frac{1}{28}$ of an ounce) of protein food or of carbohydrate food yields 4.1 calories, while the same quantity of fatty food yields 9.3 calories.

Of great importance for health is the commonplace idea continually ignored, that the amount of food should vary (*a*) with the growth, if any, that is going on, (*b*) with the work, if any, that is being

done, and (*c*) with the surroundings in so far, for instance, as they promote evaporation. Thus a youth of fifteen who is growing rapidly may require as much food as his father, and he often does not get it! Travellers on a liner, unless they are taking a great deal of exercise, are apt to lose half the value of the sea-voyage by taking far too much food, though they are often saved from serious consequences by the abundance of moving air throughout the day.

Besides the actual quantity of food there is the question of balance. The three great kinds of food should be represented, namely, (*a*) proteins, like the casein of cheese, the vitellin of yolk of egg, the albumin of white of egg, the gluten of wheat; (*b*) carbohydrates, like starch and sugar, and (*c*) fats or lipins, such as olive oil and bacon. The proportions of these three kinds of foods should vary with the work and the surroundings; thus a more or less sedentary occupation should be associated with a relative increase of protein food and a reduction of carbohydrates and fats. But reliable books on dietetics are readily available.

Of great importance are the accessory food-substances or vitamins which seem to be indispensable for health. An artificial milk can be com-

pounded by mixing proper quantities of proteins, carbohydrates, fats, and water; but if animals like rats are fed on this theoretically sound mimic milk, they cease to grow. Moreover, they develop various disorders, as the result of which they speedily die. This points to the presence of certain subtle accessory food-substances, known as vitamins. (*a*) There is the fat-soluble Vitamin A, which seems to be influential in promoting normal growth; it is present in butter, cod-liver oil, and many vegetables. (*b*) There is the water-soluble Vitamin B, whose absence from polished rice, for instance, brings about the curious disease of Beri-beri, prevented by the vitamin present in the outer husk of the rice grain. This vitamin is present in eggs and peas, and the like. (*c*) Then there is Vitamin C, without which growth stops and the bones do not form rightly (as in the disease of rickets). Its absence also involves scurvy, disorders of the breathing passages, and abnormality in the region of the eye. This vitamin is present in lemons and raw potatoes, and so on. We need not discuss Vitamin D and Vitamin E, and it should be noted that the whole subject is under discussion. Thus irradiation of the food with ultra-violet rays may counteract the absence of vitamins—a somewhat

perplexing fact. In any case a natural mixed diet supplies all the vitamins that are necessary.

§ 11. Influence of Occupations

Books have been written on the dangers associated with particular callings, but recent improvements in the hours and conditions of labour have been so great that most of these books are out of date. To the biologist, however, there is much that is very interesting in a careful treatise such as Arlidge's "Diseases of Occupations." There is no doubt that some occupations make health more difficult than others, yet there are few occupations today whose intrinsic disadvantages cannot be counteracted. Most hazardous, probably, are those which involve fine dust which in spite of inhalers is likely to get into the lungs.

It requires an expert to use without fallacy the mortality tables of the different occupations, one obvious source of error being that certain types of constitution gravitate towards certain kinds of work. There is a selection before the occupation as such begins to tell. Thus somewhat weakly constitutions tend to become clerks, who therefore do not start equal with, let us say, the clergy.

A glance at our small sample of the occupational mortality tables illustrates some of the fallacies that readily entrap the unwary. It is evident, for instance, that the mortality must be considered at

OCCUPATIONAL MORTALITY TABLES,
1910–1912

	Age: 25–35.	35–45.	45–55.	55–65.
1	Clergy.	Clergy.	Clergy.	Agricultural labourer.
2	Agricultural labourer.	Agricultural labourer.	Agricultural labourer.	Clergy.
3	Cotton operatives.	Cotton operatives.	—	—
4	—	—	—	Printers.
5	—	—	Printers.	—
6	Printers.	—	—	Shoemakers.
7	—	—	Shoemakers.	—
8	—	Shoemakers.	—	—
9	—	Printers.	Cotton operatives.	—
10	Clerks.	—	—	—
11	—	—	—	—
12	North Lancashire shoemakers.	Clerks.	Clerks.	Cotton operatives.

the various periods of life. Thus cotton operatives —subject to over-moist warm air—sink from a very satisfactory (3rd) position betwen 25 and 35 to a very low position between 55 and 65. In the case of printers and shoemakers, on the other hand, the rate of elimination diminishes as life goes on—the tougher individuals being left. Clergymen top the

list except between 55 and 65, when the first place is taken by agricultural labourers, but it would be unwise to conclude that the occupation of the clergy, who are often overworked, underpaid, and strained, is such a healthful one as the statistics at first sight suggest. It must be borne in mind that the clergy are on the whole selected from the start as highly-controlled and moralised types, marked by abstemiousness and other virtues.

It is necessary also to take account of the earned income, yet above an uncertain line wages do not seem to have much to do with health. The line is that which secures, if it is earnestly desired, the minimum normal requirements of food, space, fresh air, sunlight, and rest. The clergy are relatively a poor brotherhood, but, as we have said, they enjoy a high health-rate—partly, no doubt, the reward of living at a high ethical level. There are more poor people in Reading than in Oldham, yet the mortality is notably lower in Reading. The Oldham workers have better wages, but many of them have to work in warm moist cotton factories; in Reading the wages are lower, but more of the workers are in the sun and in gardens.

During the last fifty years (1927) the mean expectancy of life in the first year of babyhood has

greatly improved; it has gone up eleven years for boys and fourteen for girls. But this improvement is not continued at the same standard; between thirty and thirty-five the rise in the extension of life has dropped to two for males and four for females. It is obviously necessary to take into account all the successive periods of life. The general fact is that the improvement in very early life, largely due to improved conditions of health, is not quite sustained later on, presumably, in part at least, because the continued improvement in the conditions of health is somehow baulked of its full effect. Another general fact is that the conditions tell more markedly against the males, partly because they tend to be engaged in more dangerous work, such as mining, but partly also because they are less moralised than women. In some areas, such as the North-West of England, there seems to have been during the last half-century *no* improvement in the expectation of life in late middle-age—a somewhat ominous fact since there has been very striking reduction of occupational diseases in the strict sense. This is one of the many facts that indicate the readiness with which statistics lend themselves to fallacious conclusions; it is necessary to inquire into the particular work,

the particular place, and the particular people in comparing one generation's health with another's. Hence our insistence on Place: Work: Folk.

As a general rule, as measured by mortality tables and Benefit Societies' returns, country folk lead easily in healthfulness, though so much has been done for sanitation in towns. While specific occupational diseases have greatly diminished, there is no doubt that industrial life increases the incidence of certain diseases, for which the nature of the work cannot be directly blamed. Yet there are regions of the open country where tuberculosis is tragically common, largely perhaps because the unsatisfactory housing conditions tend to multiply infection in early years, and the imperfections of early nutrition tend to impaired powers of resistance.

Statisticians tell us that the death-rate varies approximately as the 10th root of the density of the population; and there is strong evidence that this is largely due to the deficiency in "fresh air" (which includes moving air) and sunshine. Two well-known authorities, Drs. Leonard Hill and Argyll Campbell, tell us that "the indoor atmosphere conditions of many offices, shops, business-houses, and factories closely approximate to the outdoor con-

ditions which pertain to such a climate as Madras and Sierra Leone. The stillness of the air in confined spaces has a most potent influence on the cooling functions of the skin, on the cutaneous nerves, and so, on the vigour, health, and efficiency." We see then how difficult it is to separate off the deteriorative influence of a particular occupation from that of the environment which is associated—yet not necessarily associated—with that occupation. As regards the rate of mortality and the less definitely measurable standard of health, the country is better than the town, because the country means more open and moving air, more sunlight and the unabsorbed ultra-violet rays, more of the vitamins in which the country food abounds, less smoke with its various pernicious influences, less crowding and less "comfortable absence of draughts." It is obvious enough that "God made the country and man made the town." And yet the Heavenly City is not a Utopia, but a Eutopia. Emerson's prevision is well known:—

> Give to barrows, trays, and pans
> Grace and glimmer of romance;
> Bring the moonlight into noon
> Hid in gleaming piles of stone;
> On the city's paved street

Plant gardens lined with lilacs sweet;
Let spouting fountains cool the air,
Singing in the sun-baked square;
Let statue, picture, park, and hall,
Ballad, flag, and festival,
The past restore, the day adorn,
And make to-morrow a new morn.
So shall the drudge in dusty frock
Spy behind the city clock
Retinues of airy kings,
Skirts of angels, starry wings,
His fathers shining in bright fables,
His children fed at heavenly tables.
'Tis the privilege of Art
Thus to play its cheerful part,
Man on earth to acclimate,
And bend the exile to his fate.

In Conclusion

In what has been said we have not done more than lay emphasis on certain fundamental ideas; but the most glaring omission is that we have not sufficiently indicated the hygienic rôle of beauty. There is profound truth in Walt Whitman's lines: "There was a child went forth every day, and what that child saw became part of him for a day, or a year, or for stretching cycles of years." It is important indeed to have well-ventilated rooms, but

it is also important to live in a House Beautiful—a home to be proud of. It is important to have a healthful occupation, but "a merry heart goes all the day, while a sad one tires in a mile." It is important to have well-balanced food, but "a merry heart is the life of the flesh," and "he that is of a merry heart hath a continual feast."

CHAPTER III

HEALTH AND HEREDITY

§ 1. Strength and Weakness both Hereditary.
§ 2. Common Misunderstandings.
§ 3. Are any Diseases Transmissible?
§ 4. Some Provisional Propositions.
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§ 6. The Other Side of Heredity.

CHAPTER III

HEALTH AND HEREDITY

§ 1. Strength and Weakness both Hereditary

The distinguished French chemist Chevreul lived an intensely active life and succeeded in becoming a hearty centenarian. Some one asked the veteran: "Have you always had a good digestion?" and received the astounding answer: "I really cannot say, for I have never noticed." This indicated an ideal state of health, a harmony so perfect that it was unobserved! However health may be defined, it means a certain balance of life, both mental and bodily, and also a certain vigour or intensity. With these two qualities goes a power of resistance to various forms of assault—microbic especially. Now, there is no doubt that these priceless qualities are heritable, and in questions of marriage and parentage, our *first* question should always be: What of the health of the stock?

Healthfulness runs in families, but the unfortunate fact is that we inherit and hand on not only legacies but liabilities. There is a sad entailment of disharmonies, weaknesses, and susceptibilities, and we have to dree our weird. But things are not always so bad as they seem, and it may be of service to try to clear away some common misunderstandings in regard to heredity and disease. There are many solemn warnings, but there are also a number of "bogies" which should be exposed, for they divert useful energy and often cause needless worry.

§ 2. Common Misunderstandings

(1) The re-appearance of an abnormal condition in successive generations does not necessarily mean that it is hereditarily transmitted, for it may be re-impressed afresh on each successive crop. Thus "collier's lung," black with dust particles, is not hereditary, though it is readily re-acquired. Does it matter what it is called if the abnormality actually re-appears? The answer is that it matters greatly whether the peculiarity is part of the inheritance or whether it is evoked by the same conditions in successive generations. In the second case the abnormality will disappear when the unwhole-

some conditions are removed; in the first case the abnormality is hereditarily entailed and is almost bound to find some degree of expression even when the conditions are wholesome.

(2) Pre-natal infection is not in the strict sense part of the inheritance. It means that the germ-cell or the embryo within the parent has been attacked by some microbe. This occurs rarely in the case of tuberculosis; it is common in the case of syphilis. The medical word "congenital," which should mean "what manifests itself at birth," has caused no little confusion, for it is natural to conclude that what shows itself at birth must be part of the inheritance. But, if one thinks clearly, one sees that this could not be said of what is acquired during ante-natal life by infection or by poisoning or as the result of defective nourishment. These results are congenital but not inherited. An interesting point is that in many insects such as cockroaches the egg is infected at an early stage with yeast-cells, which are *helpful, not harmful.* They multiply in the developing animal and come to be of great service in the process of digestion. But no one would dream of calling them part of the inheritance. Similarly with hostile microbes.

(3) In the third place, the inheritance of a pre-

disposition or bias towards a disease is to be distinguished from the inheritance of the disease itself. This is far from being an academic distinction, it is of great practical importance. For it is sometimes possible to avoid the deteriorative conditions (in surroundings, food, and habits) that turn a tendency into an actuality. As a wise authority has said: One is not (usually) born tuberculous, one is born tuberculisable. What is actually inherited is a still uncertain *x;* it is some constitutional weakness, such as great vulnerability of the epithelium of internal surfaces; but it is not the disease itself. Similarly, most authorities would agree that one is not born "gouty," but rather with some radical inadequacy in dealing with the elimination of waste-products. Under various stimuli—uncertain rather than certain—the gouty predisposition may form the basis of unmistakable gout. Conversely, habits of life which should theoretically result in gout, may have no marked evil effects because of the inborn excellence of the organism's filtering functions. On the other hand, the hereditary gouty tendency may be strong enough to assert itself in those who live simply and take much exercise. The familiar situation in novels—one thinks of the Forsytes—is that well-to-do men with a hereditary

gouty tendency give it every encouragement, say by "generous living," and thus from two sources develop very bad gout. For practical reasons it is important to understand as clearly as we can, (*a*) that a hereditary bias may find expression in spite of all that we can do, (*b*) that its expression may be attenuated by antagonistic "nurture," and (*c*) that its expression may be exacerbated when the conditions of life work in the same direction. Then the organism has to fight a battle with two fronts.

(4) The general point is that we must try to distinguish between *acquired* and *innate* abnormal states or activities. Closely similar disturbances may arise in two ways, from within—hereditarily, and from without—modificationally. Nothing is wholly from within or wholly from without, yet the distinction must be pressed for the simple reason that the likelihood of the abnormality being transmitted to another generation will depend on its mode of origin. The innate or constitutional peculiarity is likely to be hereditarily continued; the acquired or modificational peculiarity is likely to end with the individual.

To take an illustration, deafness may be the expression of an inborn constitutional proclivity, theo-

retically referable to some germinal disturbance or defect. But a superficially similar deafness may be acquired as the result of some accident. Fay's statistics on the subject show that if both parents are innately deaf, the percentage of deaf children is 25.9; that if one parent is innately deaf and the other normal, the percentage is 12; that if one parent is innately deaf and the other modificationally deaf, the percentage is 6.5; that if both parents suffer from acquired or modificational deafness, the percentage is 2.3; and that if one parent is modificationally deaf and the other normal, the percentage is 2.25. These figures are very striking, and they should be revised and extended, for they are of high practical importance.

What we are emphasising is the idea of a twofold origin of abnormal states and activities: (*a*) they may be due to some disturbance in the germ-cells; or (*b*) they may be due to something wrong in the environment, the food, and the habits. We know that the contrast "looks better on paper than by the bedside." Yet if the abnormality can be reasonably referred to some nurtural peculiarity, then the nurture may perhaps be changed for the better, and the patient may be told that what he suffers from is not likely to be handed on. But if a structural or

functional abnormality crops up when surroundings, food, occupation, and habits are all of the best, the probability is that we have to do with the outcrop of a germinal disturbance, and that it will be handed on, even if it be individually counteracted. In many cases, as we have already said, the medical man has to do with something agley that is due to *both* factors—an innate predisposition and a nurtural shove.

§ 3. Are any Diseases Transmissible?

At this time of day it may seem strange to be asking: Are diseases transmissible? Yet for the most part the answer should be in the negative! In the first place, as we have seen, no *microbic* diseases can be in the strict sense transmissible, though there may be handing on of a proclivity or marked liability, and though there may be infection before birth, as in the case of syphilis.

In the second place, *modificational* or "acquired" diseases are not in the least likely to be handed on, though their secondary effects in the parent may deteriorate the germ-cells or (in the mammalian mother) the embryo, and though they may be reimpressed generation after generation. The chil-

dren of lepers, if born out of leper districts, never inherit leprosy; but that is not to say that they may not eventually acquire leprosy as their parents did. For leprosy appears to be a modificational or "acquired" disease, not a germinal or constitutional one.

It would be outstripping the evidence to assert dogmatically that modificational or "acquired" diseases are never handed on to the offspring in some representative degree. What we say is that the present state of the evidence is preponderantly against a belief in any such entailment. No doubt there are some difficult data, such as the peculiar abnormalities in some of the offspring of rats that had been subjected to prolonged rotation on a roundabout; or such as the peculiar eye-defects observed in several generations of rabbits descended from a pair, one of which had received injections of a serum produced by introducing pounded lenses into a fowl. But these are difficult cases and the main body of the evidence at present points in the opposite direction.

Those who have not studied the question carefully are wont to adduce a case like this: Short-sightedness was acquired by a student about the age of twenty-one *as the result of an investigation*

that required much deciphering of difficult documents. Both his parents had normal vision. But the scholar's children developed shortsightedness soon after they went to school. Is this not an instance of the transmission of a definite acquired character? But the fallacy is the absence of evidence that shortsightedness is ever an acquired character or modification, i.e. directly induced by some peculiarity in function. It appears rather to be due to a germinal variation. It sometimes occurs in wild peoples who do not read at all. It is also said to occur in horses. In all probability what the case cited does illustrate is the hereditary intensification and "anticipation" of a germinal peculiarity. This term "anticipation" is technically used to denote the earlier and earlier outcrop of an inherited peculiarity,—a common feature in some nervous disturbances.

The heart is a hard-worked organ that never gets a rest. In our body it is about the size of our closed fist, and in each of its contractions, which occur 70–80 times a minute, it propels about three and a third ounces of blood into the aortic tube with considerable pressure. Under strained conditions the heart enlarges—the body doing its best to answer back to the over-work. Now this abnormal en-

largement may occur in the son as it did in the father, and one is at first tempted to say that the son inherits his father's enlargement of the heart. But in all probability what is hereditarily continued is a particular kind of constitution, which renders the son liable to acquire the peculiarity that was exhibited by his father.

Similarly, a nervous disturbance or neurosis which manifested itself after some shock or crisis, may reappear in the child without there being any known provocation. In all probability, what is actually inherited in such a case is a constitutional nervous weakness which finds varied expression according to circumstances, and occasionally the same expression in parent and offspring. There is not unanimity, but many authorities would accept the biological conclusion that when a nervous disturbance occurs in an individual without any neurotic taint—rather a rare occurrence!—there is very little reason to expect any correlated entailment.

Continuing our question: Are diseases transmitted? we come in the third place to *constitutional diseases of germinal origin*—an expression that does not attempt to conceal our ignorance, but merely means that some diseases are variations or

mutations on the minus side. Now what is hereditarily continued in such cases is not usually the disease itself (i.e. a state of disturbed metabolism or chemical routine), but a weakness, a deterioration, a defect, or a bias that makes the disease likely to occur. This is what a distinguished authority, Professor Martius, means by saying: "In the sense in which the word inherited is used in biology, there are no inherited diseases."

There are some well-known instances that seem to contradict this conclusion, but it will be found that they do not concern diseases (disintegrative processes) in the strict sense. What is called hæmophilia is the tendency to bleed profusely on receiving a slight wound or even a blow. It is restricted to males, and it is very heritable. It may be continued through normal daughters to grandsons. But this troublesome peculiarity is rather a defect than a disease. It implies that something is hereditarily lacking in the blood, which prevents the usual coagulation at a wound; and there may also be an inborn weakness in the walls of the blood-vessels.

Similarly with colour-blindness which is very heritable, continuing for many generations, usually in men. It usually passes from father to grandson

through an unaffected daughter. A colour-blind father will not have a colour-blind son unless the peculiarity was also in the mother's family. But colour-blindness is a defect, not a disease.

What is hereditarily continued (a better term than "transmitted") is often a deterioration, such as lack of developmental vigour. For some obscure reason the development lags and stops short of the perfect finish that is normally so characteristic. In a large family of twenty there were ten with hare-lip, due to a failure to close a temporary paired groove between the nostrils and the corner of the mouth. In gristly fishes like the skate, there is, so to speak, permanent and normal hare-lip, for the naso-buccal groove always remains open. Cleft palate is another well-known instance of a slight lack of finish in the development, and perhaps having only two joints in the fingers (brachydactylism) is another. Sometimes the deficiency in developmental vigour may affect the brain, so that the child is born demented. Often again what is lacking is "nervous control," and this may find many diverse outcrops in subsequent life. Another inborn disharmony is lack of balance in the regulative function of the ductless or endocrinal glands; a sad case, for the body is sound

enough, but its functions are not in tune. Our general point has now been sufficiently illustrated, that the inheritance of diseases as such is rare; there is an entailment of defects, deteriorations, and disharmonies. We quote the pathologist again: "In the sense in which the word inherited is used in biology, there are no inherited diseases."

§ 4. Some Provisional Propositions

(1) Qualities for good and ill are usually transmitted through either parent. Thus brachydactylism, or having fingers all thumbs, may pass on from either side of the house. The same is true of polydactylism (having extra fingers), some forms of cataract, some forms of St. Vitus's dance and of diabetes. Exophthalmic goitre is rare in males, while colour-blindness is rare in females. Bleeding or hæmophilia is confined to males, but the peculiarity may pass from father to grandson through an unaffected daughter. A peculiar mutation, having a somewhat spinose skin, was exhibited by a man called Edward Lambert, born in 1717. He had six children who showed the spiny character; one of these grew up and handed on the peculiarity; it was continued in some members of five generations, but in males exclusively.

In all cases, for good and for ill, the mother must count for more than the father—the reason being that there is more body-building material in the egg-cell than in the sperm-cell. The human egg-cell is 1/125th of an inch in diameter, but the sperm-cell is only 1/500th of an inch in length. Yet it must be noted that the number of nuclear rods or chromosomes, which carry many (some would say all) of the hereditary qualities (technically called "factors" or "genes") is the same in both kinds of germ-cells. Another important fact is that the maternal influence is greatly enhanced in mammals, including of course man, because of the intimate ante-natal partnership between the mother and the developing offspring.

(2) The expression of a defect or weakness may change from generation to generation. Disturbed organisms breed other disturbed organisms, but it is not always their own disturbance. A gouty father may have an asthmatic son. A particular eye defect in the parent may be continued as another eye defect in the offspring. Lack of control that expressed itself in alcoholism in the father may crop out as licentiousness in the son. A lack of nervous control which showed itself as mere eccentricity in the parent may take the form of epi-

lepsy in the child. Particularly of any unusual variation in the nervous system is it true that the expression may change from generation to generation, and also with the sex, changing from genius to instability, from epilepsy to hysteria. The same fact is familiarly illustrated on the plus side; marked ability often runs in a lineage—that of the Darwins, for instance, for five generations or more —but the forms the ability takes are very diverse.

(3) Some minus characters illustrate Mendelian inheritance, occurring in a percentage of the offspring of those affected, cropping out inexorably far beyond the third and fourth generation. This is true, for instance, of pre-senile cataract, and of some forms of diabetes, epilepsy, and feeble-mindedness. A famous instance is that of a Frenchman, Jean Nougaret, born in 1647, who was affected by night-blindness, which means an inability to see in dim light, and seems to be associated with a lack of visual purple in the retina. This was when Charles I was king of England, and ever since then the peculiarity has continued to show itself generation after generation among the progeny. If a normal member of the lineage married a normal unrelated individual, night-blindness ceased to appear along that line. But if an affected

individual married an unrelated normal, the night-blindness re-appeared among the descendants. A character that shows Mendelian inheritance does not blend or average off, but is either there or not there in its entirety in a percentage of the descendants.

What is meant by Mendelian inheritance may be illustrated in a simple way by referring to the Japanese waltzing mice which have a strong tendency to dance round in circles on the slightest provocation. They have some obscure peculiarity in their nervous system which finds a variety of expressions apart from the waltzing tendency. Thus, except for a very brief period, they are all deaf.

Now if a waltzing mouse is paired with a normal mouse, the progeny are all superficially normal. Technically it is said that normality is dominant and waltzingness recessive; but apart from the result in crossing we do not know what makes one character dominant and another recessive. Thus we formulate $D \times R = D(R)$, the letters D(R) indicating that the dominant character (normality) is patent in the hybrid offspring, while the recessive character (waltzingness) remains latent.

If the hybrid, superficially normal, mice are

paired with one another or with others of similar descent, the litters will show the following proportions:—

25 p. c. pure normals + 50 p. c. apparently pure normals + 25 p. c. pure recessives

25 D + 50 D(R) + 25 R.

The grand-offspring pure normals, sometimes called extracted dominants, are quite free from any taint of waltzingness; and if bred with others like themselves will yield only normal progeny, and so on for successive generations.

The grand-offspring pure waltzers, sometimes called extracted recessives, are quite without any trace of normality (as regards movements and so forth); and if bred with others like themselves will yield only waltzing progeny, and so on for successive generations.

But the 50 per cent. apparently normal mice are exactly like their immediate parents, D(R), as is shown by the fact that when they breed together, their progeny exhibit the characteristic Mendelian proportions: 25 D + 50 D(R) + 25 R.

The paradoxical fact is clear, that one of the grand-offspring waltzers could be conscientiously

sold as a pure waltzer although its parents were superficially normal, and although only one of its grandparents was a waltzer. In other words, it is biologically quite possible to get a clean thing out of an unclean. But this cannot be effected unless the "clean" and "unclean" characters illustrate Mendelian inheritance and unless care is taken with the breeding. The more familiar fact, sadly enough, is that deteriorative peculiarities, especially in the nervous system, are very slow to disappear, even in many generations.

(4) While some deteriorative peculiarities may continue far beyond the third and fourth generation, there is no doubt that others may cease to find expression. If the night-blind, that is to say, the bearers of a recessive Mendelian character, have no progeny, and if the apparently normal members of the night-blind stock never have children except by normal members of an unrelated stock, there will soon be no further expression of night-blindness, though that is not the same as saying that the taint will have entirely vanished from the inheritance. In many cases the severely tainted are sterile, and Sir Frederick Mott has directed attention to what he calls the "law of anticipation" —that is to say, the tendency for a pathological

state to find expression earlier and earlier in the individual life-history, until finally it shows itself even before birth and may then be fatal to further development.

§ 5. Practical Suggestions

When we are told that microbic diseases are not transmissible, but that specific vulnerability is often handed on, it often seems at first sight to amount to almost the same thing. But there is a world of hope in the "almost;" for it is becoming increasingly possible for man to lessen the chances of infection, and to increase the resistance-power of his body by attention to habits, food, and surroundings. It is also possible that constitutional immunity to some diseases is in process of evolution.

Similarly, when we are told that there is no likelihood of modification diseases being handed on, but that they may deteriorate or prejudice the vigour of the germ-cells or, it may be, the developing offspring, it seems at first sight to amount to almost the same thing. But it is not so. As Sir Leslie Mackenzie wisely says: "The nightmare of the specific inheritance of acquired diseases over-

loads the spontaneity of life, paralyses the will, and hampers the preventive service in its efforts to improve the environment." Facing the facts has made this particular nightmare almost impossible!

What cannot be ignored, however, is the probable handing on of all manner of defects and weaknesses, deteriorations and disharmonies, and against this we must struggle, trying to counteract minuses in hereditary "nature" by pluses in environmental and habitudinal "nurture." It is scientifically legitimate that we should cheer ourselves with the fact that there is much more of the wholesome and integrative than of the pathological and disintegrative in what Shakespeare called the mingled yarn of our web of life.

There is no warrant for pessimism, but in face of much hereditarily continued deterioration—more serious than any financial "national debt"—there is serious warrant for girding up the loins of our minds and endeavouring more strenuously to foster "a feeling of responsibility for the healthfulness of subsequent generations." As some one has quaintly said: "A family tree is a fine thing to have, so long as it is not shady."

Two supplementary truths must be kept in balance—the value of hereditary "nature" and the

value of stimulating evolutionary "nurture." Whether we take a biological survey or study lineages and statistics, we cannot get away from the general impression that what counts for most is inborn healthfulness. Mere curing means much for the individual, but it does not necessarily make the next generation any stronger. The fundamentally important thing is the healthy inheritance. Professor Karl Pearson tells of a coast-guardsman on an invigorating wind-swept coast, who answered the Professor's remark: "This must be a healthy place for your children," in the wise and pithy sentence: "Well, I says of children, some is unhealthy wherever you puts 'em, and again others is 'ealthy no matter where they lives." We do not accept this as a summation of the whole matter, but it is a vivid expression of half of the truth.

Similarly, in his "Fruit of the Family Tree," Mr. Wiggam tells us of a sturdy family of nine who were reared in defiance of about 95 per cent. of the laws of health, and took little harm. They used to swim in the lake before the ice was gone; they slept huddled together; the windows were nailed down till the warm weather set in; one was so weakly that *he* had to wear underclothing; one baby was almost run over as he lay sleeping in the

dust of the road; they had three square meals a day and three snacks between; and so forth. But they all grew up into strong youths, and most of them went to college. But it would be very unwise to generalise from a few cases. Even the best "nature" is the better of good "nurture"; and in a multitude of cases it is the task of parent and physician to try to counteract, for the individual at least, a minus "nature" by a plus "nurture."

§ 6. The Other Side of Heredity

About the time of Pasteur, when the idea of the biological control of life began to grip men's minds, there arose a widespread and sanguine belief that there was hardly a limit to what improvements in environment and function could do in the way of patching up a weak constitution, educating out a vice, exercising a feeble development into a strong one, doctoring-up a taint, and so on. Weismann's scepticism as to the transmission of acquired characters had not then been formulated; the distinction between the expression of hereditary nature and the imprints of peculiar nurture had not been clearly drawn; the improvement of the individual was not distinguished from that of the race. There was, we shall not say exaggera-

tion, but lack of criticism in the hopes which many entertained in regard to the efficacy of improved function and environment.

Now, however, opinion has swung somewhat violently to the opposite extreme, and it is declared that the only reliable betterment is to be found in an improvement of the intrinsic or germinal qualities of the race. Nurture is a broken reed, we are told, apt to pierce the hand of those who lean on it; nature counts for very much more than nurture. This apparent antithesis certainly misleads the laity, if not sometimes the experts as well.

By heredity we mean the organic relation between successive generations which determines the *nature* of the organism; our inquiry is in part concerned with the importance of *nurture,* the entire sphere of external influences that play upon the organism as it develops and grows. Sir Francis Galton's felicitous use of these two terms "nature" and "nurture" was suggested by a remark in "The Tempest"—"A devil, a born devil, on whose nature nurture can never stick."

Two Preliminary Notes.—Nature and nurture are *both* important; they are correlates, not alternatives; and it is misleading to pit them against one another. The best hereditary nature in the world

cannot develop without appropriate nurture; and the best nurture in the world is limited in its effects by the hereditary nature it has to operate on. The developing organism is a function (in the mathematical sense) of nature and nurture—a product, as Dr. Saleeby puts it, rather than a sum of them.

No doubt the question of the relative importance of nature and nurture is not one for opinions, but for investigation, for statistics, for measurement. To that every one must agree, and Professor Karl Pearson, Dr. Heron, Miss Elderton, Miss Barrington, and others, are to be thanked for beginning this measurement-method, which must prevail and with which every scientifically-minded person must be in sympathy.

What we are afraid of, however, is the popular misunderstanding of statistical conclusions, such as that expressed in the statement "the influence of environment is not one-fifth that of heredity, and quite possibly not one-tenth of it," a statement which offends the biological ear by its suggestion that heredity apart from environment has any meaning at all. Similarly when Professor Pearson says: "I shall not be surprised to find, when further data are available, that the nation has for years been putting its money on 'Environment'

when 'Heredity' wins in a canter," we know that he is using two words in inverted commas somewhat elliptically to save time, but it is just this sort of sentence which puts inexpert readers wrong, because it suggests a false antithesis. No inheritance or "Heredity" has any meaning unless it finds appropriate nurture or "environment" to develop in, and the results that peculiarities of nurture may bring about in an organism are conditioned by the inherited nature.

The Horoscope of the Organism.—What are the factors that determine what kind of creature a young creature is going to be, what kind of life it is going to live?

The first factor is Heredity, the organic relation between the organism and preceding generations. For this relation determines the inheritance—what the organism is or has to start with. To begin with, the organism is inseparable from its inheritance, *is* its inheritance.

The second factor is Nurture—all manner of surrounding influences that play upon the organism and that the organism plays with. Some make deep dints, some give light artistic touches. Food, home, scenery, school, air, light, exercise, play, work, education, stimulants, inhibitants, and the

influence of love itself. And along with the influence of surroundings we take that of function, use and disuse, and habits. All are included in the biological concept of Nurture.

There is a third factor, of a more shadowy kind, which different eyes see differently. One of the results of the Aberdeen University Bird Migration Inquiry was to confirm the fact that a swallow, after wintering in the South may return in Spring to the very farm steading in which it was born. That it can do so is partly, perhaps mainly, due to its natural endowments, that is to say, its inheritance; it is also due to its education, apprenticeship, and nutrition, that is to say, to nurture in the wide sense; but is there not a third fate? We refer to the cosmic factor, which some call Chance and others Providence—the established system of things in which the bird finds itself. This cosmic factor offers or withholds opportunities, it determines the chances of violent death, it is quite outside the control of the creature.

The Hereditary Assets.—The first glimpse of the other side of heredity is easily caught. Those who are oppressed by the inexorableness of the hereditary persistence of defects and blemishes, should remember that there is a similar *vis inertiæ*

in excellences and virtues; the hereditary relation also secures the entail of a big common stock of wholesome human specific characters. In point of fact the true inwardness of the hereditary relation has always been that, by a simple but ingenious device, called the continuity of the germ-plasm, it secures the entail of the big gains that are made in the course of evolution—gains which so far as we know are wrought out or devised in the arena of the germinal material, rather than elaborated by the fully developed individual.

It is true that the son of an extraordinarily gifted father is not likely to exhibit his father's excellence in full measure; he is likely to regress towards the general population mean, because of the heavy weight of mediocre ancestry. But this again cuts both ways, for as Professor Karl Pearson puts it: "It is the balance of this sturdy commonplaceness which enables the son of the degenerate father to escape the whole burden of the parental ill."

Variability.—Another correction of the fatalistic impression which the study of heredity forces upon us is to be found in variability—i.e. the continual emergence of something new. Deeply inherent in living creatures, if not indeed part of their inner-

most essence, is this capacity for change, and the hereditary relation is such that while it limits variability on the one hand, it gives it opportunity on the other. Without a considerable amount of hereditary inertia there could not have been any steady evolution; heredity secures steady persistence of character; and yet the hereditary relation admits of permutations and combinations among the hereditary items, of accumulations and suppressions, of blendings and neutralisings—and so on.

Many variations, or novelties as we may call them, are the outcome of shufflings of the hereditary cards, of the opportunities which the hereditary relation (in the maturation and fertilisation of the germ-cells) affords for the re-arrangement of characters, for the elimination of this and the corroboration of that. In any case, there is at the beginning of each new life a re-setting of characters. But there seem to be variations of another kind, qualitative rather than quantitative, genuine new departures, new patterns, idiosyncrasies, mutations. They illustrate the organism's inherent creativeness, and the hereditary relation often secures that they are entailed, so that they get more than one chance of proving their survival value in the struggle for existence.

While every one is aware of the variations which are continually cropping up in mankind, there is a tendency to look at them unimaginatively, forgetting that they are the most precious things in the world. We know them as genius, originality, idiosyncrasy, eccentricity, and so on down to crankiness, and in their finer expressions they mean reachings forwards towards supermen. But we do not know how they arise. From the experimental side we get the suggestion that decisive changes in nurture may serve to pull the trigger of germinal variability and also that the mingling of distinctive fine strains often results in some promiseful new departure.

Appropriate Nurture Necessary for Development.—Whatever may be the importance of nurture as regards the intrinsic qualities of the next generation—a very debatable point—there is no doubt as to its importance for the development of the individual life. It is essential. The hereditary nature cannot develop except in an appropriate nurture. A young fish out of water or a young chick put into water may do its best, but it will not continue to develop. Development is the expression of the inheritance in an appropriate environment.

Now, if every kind of germ had a perfectly definite nurture without which it could not develop at all, there would be no question of the relative importance of nature and nurture in the shaping of an individual life. We do not discuss the relative importance of a lock and key. For their purpose, they are equally important, since both are necessary. But it is not quite the same with the germ and its nurture, for while there are minimal conditions which must be fulfilled if development of body and mind is to come off at all, there is *beyond the minimal limit,* a variable long gamut of possibilities. This is obvious, but it has not always been clearly recognised in the discussion. The nurture may be such that it admits of development, but not of quite normal development. There are famine-babies and siege-babies and whisky-babies. It may admit of normal development, but not of full development. Or it may be so rich and stimulating that it calls forth an unsuspected wealth of nature. We see then that up to a certain limit the question of relative importance of nature and nurture is illegitimate, but beyond that limit it becomes a very interesting and practically important question. For after the minimum is granted, the character of

the nurture determines the degree to which the natural inheritance is able to express itself. Here we get another glimpse of the other side of heredity.

Picture the inheritance as a group of buds, each requiring its specific nurture. A particular bud, say a sense of pitch, may be absent, and no nurture can create one to take its place. Or a bud may become a sleeping bud and remain undeveloped, just because some particular element in the appropriate nurture was wanting. Walt Whitman speaks of the buds put before us and within us, "buds to be unfolded on the old terms." "If you bring the warmth of the sun to them, they will open, and bring form, colour, perfume to you. If you become the aliment and the wet, they will become flowers, fruits, tall branches and trees."

We have got hold of the idea, at any rate, of giving the child, at every stage of its growth, "the maximum chance of attaining to physiological fitness." When this ideal is realised, it is probable that there will be a considerable emancipation of the spirit. The shackles of the body will fall off and give the brain more free play. Already, instead of whipping the boy for supposed stupidity

(he confessed that the blackboard had always been blurred to him), we give him spectacles for astigmatism. There may have been unjustifiable hopes of what nurtural improvement of individuals might mean for the next generation, but we doubt whether anyone has ever, even in imaginative enthusiasm, exaggerated the educative possibilities of wisely evolved nurture.

It will be observed that the determination of development by the quality of the nurture works in two ways. Admirable qualities in an inheritance may never be realised adequately, because the appropriate nurture was not forthcoming. Perhaps this is true of the great bulk of us. On the other hand, undesirable qualities in our inheritance—for are not many of us still "stuccoed all over with quadrupeds," including some reptiles?—may remain largely unexpressed if we refuse them the appropriate nurture.

What has been said refers to the importance of nurture in the shaping of the individual life, and this remains certain whatever be our answer to the question whether peculiarities in the nurture of the parents affect the intrinsic qualities of the next generation. As to this question, the statistical investigations of Professor Karl Pearson and Miss

Elderton go to show that as regards the children the nurtural conditions of the parents seem to matter surprisingly little. So little, that one may be allowed to suspend judgment until more data have been collected. Miss Elderton finds that the work of the mother, the unhealthy trade of the father, and the drinking habits of both, have very little effect on the intrinsic physique of the offspring. One finds it very difficult to square this with what one sees, or thinks one sees, but the only thing to do is to make a similar investigation, if one is competent to do so and to compare results.

It is rather startling to be assured that "overcrowding, bad economic conditions, bad physical and moral conditions of the parents, have practically no effect on the intelligence, eyesight, glands, and hearing of the children." Not that those who have abandoned all belief in the inheritance of acquired characters would expect the re-appearance in the children of modifications specifically corresponding to the deteriorations directly imprinted on the parents, but we might look for general deterioration, and it is quite possible that such general deterioration, for instance in staying power, in vitality and nerve, in control, in resistance to disease, might be in process, although inquiries into

the intelligence, eyesight, glands, and hearing of the children showed practically no evil result of the emphatically evil nurture of the parents.

The truth which Pearson's work brings home to us is that, for the organic betterment of the race, the improvement of the breed is more important than improvement of nurture. Our point is simply that both are important. The dangers to which Pearson calls attention are real dangers, that improvements of nurture—of the coddling and patching up sort—without any restriction in the multiplication of unsound stock, will necessarily imply favouring the increase of that stock, and that veneering due to nurture may do grievous harm if it disguises radical unsoundness in the wood. Yet, on the other hand, care must be taken lest we mistakenly label a stock as bad in nature, when it is only bad in nurture. And against the risk of disguising constitutional unsoundness by nurtural patching up, we have to put the risk of doing gratuitous damage to sound stock by continuing to tolerate insufficient or even deteriorative nurture. Improvement of nurture may keep some unsound constitutions alive, but it also tends to make the success of the wholesome more secure.

We doubt, in short, whether there has been adequate appreciation of the improvements nurture may effect in the way of stimulating development. It may also be that changes or peculiarities of nurture have something to do with prompting germinal variations or mutations which are the raw materials of racial progress. In any case, variations are always arising; some are hits and some are misses; and it is plain that unless nurture is evolving along with the organism, many desirable variations may be born only to die. In short, on appropriate nurture the survival of variations in part depends, and thus nurture comes to have a selective influence.

Organism and Environment.—Nature in its special biological usage includes all the influences of environment and function, exercise and food, use and disuse, work and play.

As some misunderstandings have arisen through an inadequate appreciation of the intricacy of the relations between the organism and its environment, let us try to disentangle things a little.

(1) There is the relation of essential dependence between the living creature and its surroundings. The organism cannot live *in vacuo;* it is always transforming matter and energy; there is

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continual give and take between it and its surroundings. As Huxley said, it is like a whirlpool in the river.

(2) There is the slightly different relation of environmental stimulus. If the organism is to develop fully, it must have a certain range of liberating stimuli. This is the trigger-pulling function of the environment. The internal organic inheritance has its counterpart in an external heritage. We are very familiar with this in regard to mental development, which is conditioned at once by the inherent capacities and by the nurtural stimulation. As Dr. Donkin puts it, "the mind of the human adult is mainly a social product; and can only be understood in relation to the special environment with which it is in perpetual interaction." . . . "Man's mind, like his body, is certainly both born and made, but his adult mind is much more made than born."

(3) Another relation is that of temporary adjustment—the organism suffering dints, such as sunburning or blanching, fattening or weakening, which disappear when the inducing conditions have ceased to operate.

(4) Again there is the relation of permanent modification, when the organism suffers dints that

last. These modifications or "acquired characters" may be defined as structural changes in a part of the body, directly induced by peculiarities of use or disuse, or by some change in surroundings and nurture generally, which transcend the limit of organic elasticity and thus persist after the inducing conditions have ceased to operate. No convincing evidence of their transmission has as yet been forthcoming. The body is changed, but there is no satisfactory proof that the germ-cells are affected in any representative way.

(5) In a few cases, especially of prolonged climatic influence or the like, it seems as if body and germ-cells are both affected, so that the result is not merely individual but hereditary. Thus it is said that a variety of Shepherd's Purse (*Capsella bursa pastoris taraxica*) which was transplanted many years ago to a high plateau (over 6000 feet) in Asia Minor has become racially changed. It put on Alpine characters—hairy stem, and long xerophytic leaves, and it had reddish flowers. When an individual plant is shifted to-day from the plains to the plateau it undergoes modification, but its seeds when sown in the low ground give rise to plants which do not exhibit any of the features characteristic of the plateau type. On the

other hand, seeds from plants that have been on the plateau for many years produce, when sown on the plains, plants with several Alpine characters—those of the stem and floral parts. It is possible that this may be due not to an actual change in the germ-plasm of the plant, but to the inclusion in the seed of specific not living substances which are formed under Alpine conditions. Very careful experiments made by Dr. W. E. Agar on one of the water-fleas (*Simocephalus*) showed that an abnormality produced on the parent might re-appear in the offspring (and even to a slight extent in the grand-offspring) living in normal conditions. But Dr. Agar's interpretation is that the abnormal environment which modifies the parent does so by producing specific non-living substances which re-act on the living matter, that these when once formed are not immediately got rid of, that they come to be included passively in the living matter of the germ-cells, that they pass passively into the body which develops from the egg-cell, and that they there produce the same effect as they produced on the body of the parent which acquired the modification in question. The manner in which the modifications Dr. Agar studied waned

away in the second generation is very suggestive.

(6) There is, furthermore, the relation of variational stimulus. That is to say, some change in the ordinary environment may provoke a change in the germ-cells without producing any apparent modification in the body of the parent. This has been particularly well illustrated by Professor Tower's experiments on potato-beetles which he subjected to unusual conditions of temperature and humidity when the reproductive organs were at a certain stage in their development. The parental body was unaffected—naturally enough, perhaps, when we consider the non-plastic character of a beetle—but in a certain number of cases there were in the offspring remarkable changes in colour and markings, and even in minute details of structure. The divergence of the offspring was transmitted and there was no reversion to the parental condition. Tower's experiments suggest that environmental influences may saturate through the body and stimulate the germ-cells to variation.

(7) Then one must remember that changes in the environment, especially in the case of higher animals, often induce not a parry, but a thrust. For living creatures are agents, not passive pawns.

They act on their surroundings, modifying them; they seek out new environments and conquer them; to some extent they sometimes make their own environment.

(8) Finally, the environment acts as a sieve and as an isolator. The elimination, moreover, is not necessarily fortuitous or haphazard; it may be definitely discriminate. The system of inter-relations gradually wrought out in the course of ages has in a measure a selective influence.

The tendency to take too simple a view of the influence of nurture is seen for instance in those who somewhat naïvely write down all the deteriorative characters of slum-dwellers to slum nurture. Mr. Lidbetter and others have pointed out that while bad housing and the like are correlated with high infant mortality, much tuberculosis, much mental disorder, and so on, it is far from being a simple matter of cause and effect. There are people of low mentality and with little grit, they get forced into unhealthy trades, they acquire occupational depression, they form the habit of taking the usual shortest way out of slumdom, they get all wrong with their diet, the mothers have to go out to work at low wages, the children are neglected, the force of social suggestion is strong

against them. Often too, there is casual marriage and inbreeding, all sorts of arrears accumulate—physical, physiological, and moral—and finally the dwellers in darkness lose heart altogether.

Now, it is an error to sum up the situation by saying that the slums produce the slum type; and it is equally erroneous to say that people of a hereditarily slummy type make the slums. The biological truth is a combination of these two half truths. An inferior type gravitates to the slums, and the slums make their badness worse.

But the remarkable fact is that in spite of the encrustation of deteriorative modifications on the parents, and the evil effects of defective nurture on the children, some of the latter do excellently well under new conditions, like plants shifted to a good garden. This is probably most frequently the case when the deterioration of the parent was modificational rather than hereditarily inherent, but who is wise enough to discriminate? In any case the fact lends hopefulness to ameliorative measures.

Modifiability.—If modifications be defined as changes impressed upon the individual as the result of peculiarities of nurture, we recognise that they may be of great importance to their possessor.

They may afford a life-saving protection; they may counteract hereditary deficiencies. The experimenter may alter the colour of crab and caterpillar, the size and shape of limpet and Japanese tree, the eyes of gold-fish and the plumage of birds, and a hundred other characters.

In most cases, however, these modifications are not transmitted as such or in any representative degree. It is probably quite safe to say that Weismann gave the death-blow to the theory of the transmission of modifications in its old Lamarckian and Buffonian form, but it is probably a mistake to assert that peculiarities of nurture have no racial significance. Apart from what has been already said regarding the importance of the quality of nurture as determining the degree of fulness with which hereditary nature develops, in what other ways may nurture be of importance to the race?

There are several considerations to be borne in mind. Although peculiarities of nurture do not affect the germ-plasm in a definitely representative way, corresponding to their effect on the body of the parent, they may have a general effect in the way of weakening or strengthening or poisoning, or even a specific effect in the way of inducing a germinal variation. Some recent work is pointing

towards the possibility that long-continued or very deeply saturating external influences may induce peculiarities in the offspring, and that these may persist for several generations at least, after the inducing conditions have ceased to operate.

Even if modifications due to peculiarities of nurture do not take a grip of the hereditary nature, it is man's prerogative to secure that these modifications, if desirable, be re-impressed on each successive generation, and contrariwise, if they are undesirable, that they be avoided. Although what is acquired by the parent may not be inherited by the offspring, what is not inherited may be re-acquired.

Those who deplore the non-transmission of the progressive modifications acquired by individuals as the result of peculiarities of environment and function, forget that this applies also to deteriorative modifications which happily seem to die with their possessors. It is extraordinary how tough the germ-plasm may be. Thus lead-poisoning, with the lessening of which, especially for women, the name of Sir Thomas Oliver is so honourably associated, may wreck the health and shorten the life of the mother, may kill one unborn offspring after another—even twelve in succession—may result in weakly, rickety, epileptic, short-lived children, in

dwarfed infantile survivors—men of twenty-one looking like boys of fourteen—and so on in horrors that make every decent man or woman ashamed, for we are all involved in these things willy-nilly. There is enormous wastage of life, but the extraordinary fact is, that it seems difficult to make any definite statement as to the racial effects of plumbism.

Another point is that though acquired characters do not take racial grip, they may act as a screen until heritable variations in the same direction have time to evolve. We read that the natives of Cashmere carry in winter a little charcoal stove bound in front of their body. Suppose that this stove was part of the body, and that it arose as a modification or acquired character, being wrought upon each individual as the direct result of environmental peculiarities. We do not know that it would ever form part of the inheritance, not even in a thousand years; but if it were re-impressed on each successive generation as a seasonal modification, it would save the lives of untold natives of Cashmere until perchance a constitutional and heritable variation—of germinal origin—had time to evolve.

The Social Heritage.—The other side of heredity is once more to be discerned when we come back to

the familiar fact that man is a social person. Besides the natural inheritance, both bodily and mental, whose vehicle (in some way that we cannot conceive) is the germ-cell, there is the social heritage of tradition and custom, of institutions and laws, of literature and art, of morals and religion. If the natural inheritance be called fundamental, as indeed it is, the social heritage may be called supreme.

Summary

A fatalistic impression is forced upon us by the inexorableness with which defects and taints and vices of body and mind are handed on from generation to generation. But this is in some measure relieved when we remember (1) that heredity also secures the entailment of all manner of wholesome qualities; (2) that there is continual variability, affording new raw material for further progress; (3) that the quality of the nurture (which is largely in our hands) determines the degree to which the buds of good qualities in our inheritance may be made to unfold, and the buds of bad qualities may be kept dormant; (4) that there is an undeniable moulding power in changes of function and en-

vironment, and though the resulting modifications do not seem to be transmissible as such, they can be re-impressed, if desirable, on each successive generation; and (5) that in man's social heritage, which is as supreme as his natural inheritance is fundamental, there are ever-widening opportunities for transcending the trammels of protoplasm.

The basis of efficiency is inborn, constitutional, germinal, but making the most of this basis depends on the nurture. The nature or inheritance is the seed-corn; nurture is the soil and the sunshine, the wind, and the rain. Nurture can create nothing, but without appropriate nurture nothing can develop aright. As Goethe said: "What you have inherited from your ancestors, use it, if it is to become your own." We cannot make a silk purse out of a sow's ear, but we may perhaps trade with our talent so that it becomes five or possibly even ten talents.

CHAPTER IV

HEALTH AND THE CURVE OF LIFE

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CHAPTER IV

HEALTH AND THE CURVE OF LIFE

The course of life is often comparable to the curve of an arched bridge. There is an ascent from the delicacy of early development into the vigour of youth; there is the strength of maturity; and then comes the downgrade of ageing. From vita minima to vita minima, the old biologists said. There is an ascending and a descending curve, separated by a more or less level stretch—the time of life's fulness; but along all the line there are minor ups and downs, more marked in some people than in others.

§ 1. Various Life-curves

The trajectory of life is picturesquely clear in annual plants—the tender seedling, the growing leafing sapling, the climax of vegetative vigour, the reproductive period of flowering, the ripening

of the fruit and the scattering of the seed, the waning of vigour, the withering of leaves, the sinking down into death. The story is much the same for many an annual animal—perhaps the Common Shrew is often an annual!—and if the life is continued for many years, there is still in most cases a seasonal punctuation. But whether this is the case or not, there is the general curve—from tender infancy to buoyant youth, to eager adolescence, to assured maturity, to hints of ageing, and then into the shadow of death.

The life-histories of different kinds of living creatures differ in the relative length of successive areas in the life-curve, and this is a stimulating idea for man, since it may be increasingly possible to shorten or lengthen the various chapters in a normal life-course. Can youth be prolonged, can senescence be stopped before senility begins, can we change our trajectory?

Some animals have a very long youth as compared with their full-grown life; thus Mayflies may be aquatic larvæ for two or three years and winged aerial insects for two or three days! In one case the adult life is said to be all over in an hour!

Some animals have a short, as it were telescoped, youth; thus some young mound-birds, hatched out

in a heap of fermenting vegetation, rush off at once into the business of life in the scrub; and some can fly on the day of their birth. We do not know whether the old birds show any interest in the young ones, but in many cases they have already left the district. In any case it would be a clever parent that knew its own offspring.

Other animals show a prolonged youth, a rapid adolescence, and then an abrupt ending. The transparent knife-blade-like glass-eels take two years and a half to make the long journey from distant Atlantic stretches (towards the Bermudas) to the European coasts, and they change into cylindrical elvers on the way. They ascend the rivers, continue growing for five to eight years, become reproductively mature and restless, descend the rivers, make persistently for Atlantic spawning-grounds, liberate the eggs and sperms, and die. For no mature eel ever returns from the open sea to the rivers, and no eel ever spawns in fresh water. The abrupt full stop in the punctuation of the life is also seen in the large lampreys, which die after spawning, and in such widely separated animals as various moths and butterflies which do not survive reproduction.

Again it is interesting to notice cases like ele-

phants, where there is a long ante-natal gestation, a long suckling, a long youthful period (sometimes ten years) under the mother's charge, a long maturity, and a long very gradual ageing—usually ending abruptly in a violent death. This reads like a highly successful life.

But we must not linger over these natural history illustrations, though they are useful to illustrate the general idea that the respective lengths of the different arcs on the curve of life are variable. One life-history often differs from that of a related type in the lengthening out or telescoping down of a particular chapter. As regards backboned animals we know that this change in the "timing" of life might be effected by variations in the activity of those ductless or endocrinal glands, like the pituitary body, which have to do with the regulation of growth, or in the precocity or retardation of the endocrinal tissue in the reproductive organs, which has to do with the oncoming of sex-maturity and the assertiveness of its urge.

Each arc in the human life-curve has its finenesses and its follies, its risks and its promise, its tragedies and its happiness; and our object is to consider each in turn from the biological point of view. Thus such counsel as we can offer is general,

and in idea not like the specific advice of the medical expert.

§ 2. Before Birth

That shrewd pre-Darwinian evolutionist, Robert Chambers, the author of the "Vestiges of Creation," gave an instance of his shrewdness in calling attention to the importance of the long ante-natal period (gestation) in man and in various types among the higher mammals, e. g. horse and elephant. For this period, eleven months in the elephant, allows of great progress being made before birth, so that the newly-born organism is very richly endowed. It allows the brain-cells to multiply in quietness, before any urgent demands are made on them; and here it should be kept in mind that we get no new nerve-cells after we are born. New linkages and differentiations and activations there are of course, but no increase in numbers. Moreover, in mankind and in all mammals except the two primitive types that lay eggs there is an intimate ante-natal partnership between mother and the unborn offspring. This is effected by means of the placenta, which is hardly more than hinted at in the pouched-mammals or marsupials, but comes to its own in

others. It implies a very complex interlocking of the fœtal membranes (may one say pre-birth robes?) of the developing embryo with the wall of the mother's womb, so that the blood-vessels from the one are separated from those of the other only by tissue-paperlike membrane. Thus there is interchange of fluids, but no solid particle can pass, unless by rare mischance a microbe. From the mother's blood there is a transference of oxygen, dissolved nutritive substances, and the subtle chemical messengers called hormones which stimulate and also soothe. From the blood of the offspring there is a transference of carbon-dioxide, dissolved waste-products, and, according to some authorities, hormones which make for the nutritive welfare of the mother. Thus we must replace the old and ugly picture of the unborn offspring as parasitic in its mother with the truer picture of a partnership or symbiosis. On the whole, no doubt, the offspring, the sleeping partner, gets more than it gives, for the mother cannot be a creator for nothing. Yet there is more than a one-sided sacrifice.

Some visualisation of the mystery which is so carefully hidden away, "secretly and richly wrought in the deep of the earth," cannot but suggest that the health of the mother should be held

sacred on behalf of the unborn child. The placenta is in some measure adapted for keeping back as well as for allowing through, but this adaptation must not be overtaxed. It is a commonplace, of course, that the unborn offspring's well-being is affected by the nutrition and habits of the mother, but the fact would be more imperative, perhaps, if the circumstances of the case were more vividly realised. There should be an old-fashioned nurture and a quiet environment when the offspring is being "knit together," as the Psalmist said, "in its mother's womb." "Its substance, yet being imperfect," should be shielded, as far as may be, from artificial stimulation.

We may illustrate the risks by reference to Dr. E. I. Werber's experiments on the developing eggs of the American Minnow (*Fundulus*). He found that if these were subjected to the influence of minute quantities of butyric acid, the result was an astounding occurrence of monstrosities, especially affecting the anterior end of the embryos. Weird malformations occurred, affecting eyes, mouth, heart, and fins. It seems that the butyric acid brings about a disarrangement and in part a solution of the germinal material. Now this might be regarded as a sort of experimental curiosity,

since butyric acid does not occur in the natural environment of minnows. On the other hand, when we learn that a disturbance in the chemical routine that goes on in our body in reference to the carbohydrate (e. g. sugar and starch) part of the food may result in the production of butyric acid, we see the experiments in a new light. For if butyric acid were thus produced in the body of a mammalian mother with young, it might be carried by the blood to the placenta, and might diffuse through into the developing embryo, there setting up disturbances which end in monstrosities. In any case we do well not to under-rate what the late Dr. J. W. Ballantyne, a distinguished specialist on these matters, called "the mysterious wireless telegraphy of ante-natal life."

§ 3. The Biology of Babies

Then endeavours expressed in the quietly persistent movement which have their annual climax and pageant in "Baby Week" must commend themselves to biological convictions as well as to humane sentiments. Their end is the conservation of life, and it must always be good to save lives that are worth saving. There is always the theoreti-

cal saving clause to life-saving but practically we have no alternative. That drowning rascal may not seem to us anything but a drag on society, yet if we can throw him a rope, we must. That hopeless invalid, wracked with pain, ever crucified afresh, what greater kindness than a euthanasia, yet are we or the times moralised enough for this way out, if way out it is? These babies, born old and born diseased, handicapped from the start, what cruelty to the future to let them live. Yet, not to speak of (1) our ignorance, or (2) the danger of disowning our responsibilities violently, or (3) the outraging of our humane sentiments as at present evolved, we have to bear in mind (4) the historical fact that some men and women who began even as these weaklings have been makers and shakers of the world. Who, in modern times, has changed man's life more than Sir Isaac Newton, whose genius was the root and shoot that has borne all the gorgeous inflorescence of modern inventions, and yet is it not recorded that he was one of the miserablest infants ever seen. The question is as urgent as to whether underpar babies should ever have been born, but when they are with us we must obviously try to do our best for them.

We wish to state simply how a biologist, as a

biologist, looks at babies. Their supreme interest for him is as potential new departures in evolution. For at the beginning of each new life there is a shuffling of the hereditary cards which may result in a unique "hand"—to be played for good or ill. To change the metaphor, the web of our life, as Shakespeare said, is of mingled yarn, good and bad together; and every baby is in some measure a new pattern—sometimes, alas, a knotted and tangled one—of old strands of personality. More than that, however, there probably is, namely, the making of a new creature, in some way a new synthesis. For the fundamental fact of variation is deeper than all our metaphors. Life is unceasingly creative.

No doubt some of the variations are on the minus side. Some item in the inheritance may be lost altogether in the manœuvres of the ripening germ-cells. Yet it is possible that certain of these losses may be gains, for every one hopes that some of our hereditary strands may become more and more attenuated. We wish to "let the ape and tiger die." As for variations that are distinctly and definitely deteriorative—minus variations in regard to which doctors do not differ—what can we do but try to diminish the sowing of more such tares, and seek

by beneficent nurture to counteract in some degree the individual baby's unhappy bias.

This brings us to the biologist's second impression of babies, that they are delicious bundles of buds, whose unfolding depends on nurture. No one can add to or take from the number of these hereditary buds. If the sense of pitch is absent, no number of music lessons will bring it into existence. One cannot, so to speak, make bricks without straw. It is folly to try to make a railway signalman or a landscape painter of a baby born colour-blind. But while the number of buds cannot be added to, what will become of them in the individual lifetime depends on the sunshine and the rain and the soil. When there is what one might call generosity in the nurtural influences, which are manifold, then the buds will have a free unfolding. But when the nurture, psychical as well as physical, of course, is niggardly, then the buds may never come to their own. Some of them may even relapse into "sleeping buds" which never open. Behind the hard work and the warm enthusiasm of those who promote "Baby Weeks" there is the sound biological conviction that the degree of individual development depends not only on the hereditary "nature" but also on the environing "nurture." Every amelio-

ration of nurture, whether in surroundings, food, or habits, encourages wholesome development and makes it less likely that a promising new departure will relapse into a "sleeping bud." And again there are anachronistic buds which may happily remain unopened if the appropriate liberating stimulus is never forthcoming.

No one who visits a baby-show can remain a victim to doctrinaire equalitarianism. What variety of endowment! What variety of disability! The trend of modern biological experiment is to show that no amount of good nurture will increase the individual's endowment of hereditary buds. If we take the talents in the immortal parable to mean hereditary characteristics of a definite kind, such as a strong heart, or a rapidity of nervous reaction, or a resistant pulmonary epithelium, or a sense of humour, none that is originally absent can be gained, but those that are present may be raised to a higher power, and that depends largely on nurture. Faraday was a genius born in what are called "very poor circumstances," what a tragedy for mankind it would have been if the Faraday baby and boy had not received appropriate nurture. No doubt genius is likely to be stronger than circumstances, but "nature" must have its "nurture"; and

for lack of it how many buds of genius may remain unopened even to-day.

To the biologist it seems clear that progress in the expression of animal individuality or animal personality has implied reducing the size of the family and making more of the few. Two kinds of change have proceeded *pari passu,* working into each other's hand. With keen wits and strong kin-sympathies a race of animals can hold its own with greatly economised reproductivity. But the smaller the family admits of a more scrupulous parental care and favours the survival of the socially-minded and the ready-witted. Along many lines among animals we see the spawning method being replaced by the parental care of a small family. So must it be with man; *it would be a happier world if there were fewer of us;* so we want not more babies but better ones, quality before quantity all the time. And *the recipe for better babies is better parents*—one in the eye for us!

§ 4. Tender Years

What has the biologist, who knows about caterpillars, tadpoles, and chicks, to say about human infancy?

(1) The helplessness of the human infant has implied from the evolutionary point of view, a prolongation of the ante-natal shelter. If there was to be survival at all, there had to be parental care, and that of considerable intensity. But this must have had, we think, some deeper advantages, since it is quite possible to conceive of infants being born as precocious as chicks. What are the deeper advantages of a prolonged sheltered life, relatively passive? Part of the answer is that it allowed a longer period for quiet brain-development without loss of plasticity. As we have said, there is not after birth any addition to the *number* of nerve-cells in the fore-brain or cerebral cortex. The infant has to start with the full number of 9300 millions, but these have to be activated, interlinked, differentiated; and the more gradually and quietly these changes come about, the longer the brain will continue to be plastic and educable. The quicker a young creature is to react to responsibilities, the sooner will it reach its limit of plasticity and variability. Compared with an animal like the young otter, the human infant has few instincts in the zoological sense of ready-made capacities for doing apparently clever things in a routine that requires no learning. But while this poverty in inborn in-

stincts is in some respects a disadvantage, it is far more than counterbalanced by the educability that distinguishes the higher animals so markedly from the lower.

(2) Lucretius expressed a great fact picturesquely when he said that "children by their caresses broke down the haughty temper of their parents," for there can be no doubt that the prolonged human infancy was a factor in the evolution of human gentleness. Types that disowned their offspring would automatically tend to die out in the course of Natural Selection, for in early days their offspring would perish. Gentleness is obviously a virtue much older than mankind; variations in degree of gentleness would occur in early days just like variations in other qualities; there would be found in the prolonged helplessness of the human infant a situation that would favour the gentler variants. Moreover, a family and social tradition approving of parental care would gradually grow. The American philosopher Fiske was early in recognising the evolutionary value of the prolonged human infancy, and it is a factor that still operates, not only on the individual, but indirectly on the race. It will be plain that we are seeking to get away from the over-simplicity of the old view that pro-

longed infancy engendered individual gentleness, as it does, and that the resulting amelioration of character was hereditarily entailed; for this theory requires more evidence than has been forthcoming as yet.

(3) In the early years of human life there is, no doubt, *some* general recapitulation of past racial history. In some respects the child-mind agrees with our idea of the mind of primitive man, in some respects the mind of the clever ape. The worried mother often addresses the impish experimenting child as, "You little monkey!" and we often see a vigorous child feeling its way into the world and trying to be a cause, just as a young chimpanzee sometimes does. An ape's ploy of drawing a chair gently backwards on the hind legs and then skipping away as it fell is very suggestive of some of the half-mischievous, half-experimental ways of young children.

The problem of tender years is to supply liberating stimuli which will evoke latent qualities. There are several considerations to be kept in mind, instead of leaving it all to affectionate haphazard. (1) The provocatives or evocatives should not be too modern, too sophisticated, too "grown-up." Thus many of the toys for young children are far

too complex,—more suited, indeed, for their grand-uncles. (2) Yet the other extreme is having the evocatives too primitive. The quality of beauty cannot be prominent too soon, and even a plaything should touch the string of imagination. How pleased even a young chimpanzee is to discover that it can produce a note by striking a taut wire! (3) Although the child is not going to live in Wild Nature, it may be possible (for the rich it is easy) to supply some of the fundamental impressions of the country—the waving branches of the trees above the cradle, the sunbeam dancing on the walls and roof of the room.

We cannot think of tender years without arousing a sad and a cheering reflection. The sad reflection is that so many die unnecessarily, through infections that might be avoided. As this elimination is in most cases quite indiscriminate, cutting the life-thread for the healthy as well as for the weakly, even the hard-shelled biologist must wish success to all the endeavours that are lessening infantile mortality. The cheering reflection, to which we have alluded in speaking of babies, is the never-ceasing crop of promising new patterns or idiosyncrasies. No doubt there are retrogressive as well as progressive variations, but the stronger trend is in the line of

the past—*in the line of advance.* These promising new departures are to be regarded circumspectly, for the little child is always leading the race.

§ 5. Childhood

The biologist knows about lambs and kittens, what has he to say about children?

(1) In the first place, childhood implies a continuation of the mysterious process of *development,* in which the inherited "nature" is expressed under the influence of appropriate "nurture." There is continued need for food and rest, and for evocative stimuli. When an apparently healthy child is "not interested in anything" and simply does what has to be done, we must confess to some failure in supplying the appropriate awakening stimuli. The child's leisure time must be safeguarded, and new notes must be sounded, far beyond those that the Montessorians have wisely suggested. Thrills are as necessary as meals, but we must, of course, remember that the child is a tender plant, with a personality like the fairy palace whose building stopped whenever an intruder began to inspect.

(2) In the earlier stages of the development of the chick within the egg, there is a gradual emer-

gence of the obviously complex out of the apparently simple. The tissues and organs are laid down, but it is at first a very minutiose kind of activity, remotely like the building up of a crystal. It looks as if the inertia of the inheritance was spontaneously able to form an organ like a lung, although this is not being used. But this continues only for a certain time, for a stage is reached beyond which the lung will not develop unless it is used. Even before hatching there is the beginning of breathing, when the little creature gets its first breath of air from the air-chamber at the broad end of the egg. This is a somewhat prolix introduction to the obvious statement that the development which is continued in childhood must be associated with active function. The child must be up and doing, using its lungs metaphorically as well as literally. Developing means doing, and we are slow to recognise the extent to which a child is a motor-organism. No school hour, for instance, should be more than forty minutes at the most, and there should be a romp between hours. It is not meant, of course, that children should be always on the hop, for the habit of sitting quiet and remembering, if not thinking, should be begun early.

(3) It is difficult to exaggerate the impression-

ability of childhood, both to sights and sounds. As Whitman said, What the child sees becomes part of him; and it may be potent, for good and ill, even when it is forgotten. For there can be no doubt that many things we thought the children did not see became part of their Primary Unconscious. We should try to save children from foul sights and words. What a lash there is in one of Dostoevsky's novels: "You may not have noticed the child, but he has seen you, and your image, unseemly and ignoble, may remain in his defenceless heart. You don't know it, but you may have sown an evil seed in him and it may grow."

(4) For some reason that is not very clear, hormones or chemical messengers are formed before birth in the reproductive organs and distributed by the blood throughout the body. But after this preliminary activation there should be a long period of quietude, and no one can do a child a worse turn than the ignorant nurse or parent who fondles in such a way that sex is wakened when it should be soundly sleeping.

§ 6. The Biology of Play

The importance of play as a factor working towards health is undeniably great; it goes much

deeper than even its most enthusiastic non-biological devotees are aware. Let us think for a little of the significance of animal play, taking a few simple illustrations.

One of the familiar yet fascinating sights of Spring is the play of lambs. Three forms may be distinguished. First we may see the lambs running races, which they do with great zest. A second game is of the "King of the Castle" type; one lamb will occupy the top of a hillock and another will butt him off, only to be himself dislodged in turn. This is evidently great sport. Thirdly, there is a game like some form of "tag," when a little troop chases one, who soon joins the pursuers and shares in chasing another. At any rate, it looks like that. What is the meaning of this animal play so familiar to us in kittens and puppies, in lambs and kids, and very well known in otters and stoats, in foxes and bears, in squirrels and rabbits?

There is something in the oldest answer, that the young creatures are overflowing with energy and high spirits. Spare energy will naturally express itself, and emotion tends to find a safety-valve in motion. But this would explain only a general playfulness, not the occurrence of particular games.

To Professor Groos in particular we owe the

suggestion that different kinds of creatures (mammals especially) have definite play-instincts, inborn promptings to certain games or plays which have a precise relation to the responsibilities of adult life. The young carnivore plays at catching booty; the young goat plays at climbing and jumping; the lamb plays at running and leaping; the squirrel plays at launching itself from one branch to another, and so forth. Thus play tends to be the young form of work, a preliminary canter before the responsible race begins, a joyous apprenticeship when consequences are not too serious, a testing of inborn or instinctive capacities whose point is often sharpened by intelligent learning in the course of the play-period. There is a deep biological reason for learning to "play the game." The poet Schiller and the philosopher Herbert Spencer said: "Animals play because they are young"; and we have admitted that this view is so far true. But it requires to be supplemented by the view of Groos, that play is the apprenticeship to life-work, and that some animals take advantage of their youth in order to play.

There is a third significance in play, that it offers opportunities for testing new departures or originalities. Animals are variable; the fountain of

novelties rarely runs dry. But the forthcoming variations or mutations require a fair chance, and they get this in the play-period more readily than later on when the criticism of the struggle for existence has begun to be severe. Not that a distinctly advantageous new departure will not be tested and approved of in the struggle for existence, but it is intelligible that many delicate idiosyncrasies will be more generously tested in play than in work. Doubtless this cuts both ways, for undesirable peculiarities may be blunted or repressed in play, so that they do not cause friction when serious life begins. All this applies to man as well as to beast, and we have never agreed with those superior persons who scoff at "the playing fields of Eton." What is desirable, however, is that play should be many-sided, and should include scouting as well as cricket.

"All work and no play makes Jack a dull boy"; but in spite of all its play the promising lamb becomes a very stolid sheep. What does this mean? The answer is that under man's shield the domesticated sheep lives a sheltered life—at least till man is hungry. It is provided with abundant food; it is protected from all enemies; it is prevented from exploring; it is promptly eliminated if it shows any

originality or insurgence. The sheep is a diagram of the nemesis of the too sheltered life. Its brain, which is promiseful in the lamb and reasonably active in the wild sheep, becomes dull for lack of exercise. And the stupefying influence of the absence of adventure is aggravated by the gregariousness. The whole social atmosphere is against originality and redolent of "Safety First." Perhaps the most tragic aspect is that when a lamb continues a little too long in being playful it is confronted with the amazed disapproval of a hundred shocked mothers and another hundred dulled uncles. Who could be original under such a gaze? It is lucky for us that this nipping of buds never occurs in mankind.

To sum up: Play is important for the health of youth, (*a*) because it is a wholesome safety-valve of pre-human origin; (*b*) because it allows the organism to test not only its ordinary powers but its originalities before responsibilities are too critical; (*c*) because it bears some relation to the business of life, being in some measure "the young form of work"; and (*d*) because it develops a "give and take," a subordination of self, and a loyalty to the team, that are of great social value. It is not merely that all work and no play makes Jack a very dull boy indeed, we stand by the thesis that

part of the best training for citizenship is in the playing-fields. And if we take play in a broad sense, as much more than games, we may say: He worketh well who playeth well.

§ 7. Adolescence

The adolescent period is a long stretch on the ascending curve of life when childish things are put away, when the juvenile is moulted off, when adult characters are put on and heavier responsibilities are assumed, when the limit of growth comes in sight, and when sex-impulses rise from whispers to loud voices.

There are three big facts to be kept in mind in thinking of adolescence.

(1) As there is for a short time a re-acceleration of growth, there is need for plenty of rest, sleep, and food. This is not of course in any way inconsistent with abundance of play and exercise in the open air. The problem is to avoid "adolescent strain" at a time when vigour seems inexhaustible and spirits are high.

(2) During adolescence there are various re-arrangements in the body, increased nervous complexities, new ambitions, and new controls. There

are metaphorical "growing pains" (the literal ones being probably rheumatoid)—each a promise and a portent, a portent and a promise. From the nature of the case there is some instability and fecklessness, and society is not slow to sift. Yet, unless we have very short memories, we will surely pardon much to the adolescent who is entering into his or her kingdom, and sending out all manner of tentatives, not to be criticised too stringently. Life stretches out before the adolescent like a delectable country with a very distant horizon.

(3) It is in adolescence that the hormones from the reproductive organs begin to saturate through the body, activating changes in structure and in function, influencing emotions and outlook. To some the assertion of the sex-urge comes like a rosy dawn; to others it is as if a legion of devils were let loose. We venture on a few pieces of advice: (*a*) One should be careful not to make a scapegoat of "sex," attributing wholly to it what is partly due to the poverty of one's own nature, a lack of resources and responsibilities, and an exaggerated pre-occupation with one's little self. (*b*) We should always face the facts and let light in. There are wise books to be consulted, which may obviate unnecessary fears. A book like F. H.

A. Marshall's "Physiology of Reproduction" should go far to dispel prurient brooding. (*c*) One should try to think big about these things—they are tests of chivalry and control. For one looks forward to a noble love, and the sex-urge is its physical basis. If we damage the roots, the flowers will suffer. (*d*) Every young fellow should refuse the lie that continence is dangerous to health, for the opposite is true. (*e*) Why not fall in love —keenest of spurs, strongest of curbs—and look forward to early marriage, even if it mean birth-control? "Be adventurous" with even the more far-seeing explorers, like Nansen.

§ 8. Falling in Love or, rather, Rising

Genuine falling in love is not a passing fancy, nor a sudden lust of the flesh; it is a reaching out of the whole being, impulsively rather than deliberately, intuitively rather than rationally. At its best there is no mistaking its voice, for "that's my own true love," and "that's the man for me."

Love is an attraction of body, sense, and mind. It implies (1) an instinctive fondness or organic attraction without which all is vain; (2) an æsthetic attraction to qualities of voice, eyes, gesture, and manner—even of dress, when that expresses some-

thing of the person; and (3) a sentimental psychical attraction of personality for personality, and without this, again, all is vain. One never can tell, but too specialised an attraction—too physical, too æsthetic, or too intellectual—is least likely to be a success. As Mr. H. G. Wells has said "There is gold and clay, sunlight and savagery in every love-story"; but those who pitch it high are seldom disappointed of their reward. Without being too severe, one should avoid profane jocularities on the subject: falling in love, or, rather rising, is one of our great chances of being noble. We should take a hint from some of the birds who have a long and subtle courtship, during which they establish psychical linkages which last after those of *fondness* have lost some of their strength.

Falling in love is not only in itself joyous and wholesome, it should be an ethical inspiration, and it should be an incentive to health. When we read that there were recently towards half a million syphilitic people in London, perhaps three millions in Britain, and often 10 per cent. in the population of a large seaport; when we think of the suffering of the innocent with the guilty; when we picture the indescribable cruelty of the lower forms of prostitution, and the dishonour of it in every form—

how can one but welcome everything that moves man to try hard after *clean living*. Is it not worth cherishing an enthusiasm for health, if only that men might come to marriage with a cleaner record?

It is well for us to be stung by the words of a sad mad genius:—

"I have a question for thee alone, my brother: like the sounding-lead cast I this question into thy soul (that I may know its depth). Thou art young, and desirest child and marriage. But I ask thee: Art thou a man entitled to desire a child?

"Art thou the victorious one, the self-conqueror, the ruler of thy passions, the master of thy virtues? (Thus do I ask thee.)

"Or doth the animal speak in thy wish, and necessity? Or isolation? Or discord in thee?

"I would have thy victory and thy freedom long for a child. Living monuments shalt thou build to thy victory and emancipation.

"Beyond thyself shalt thou build. But first of all must thou be built thyself, rectangular in body and soul."

§ 9. The Study of Sex

"How can we best study the problems of sex?" This is a straightforward question, yet it is with

no great confidence in one's own wisdom that one tries to give an answer. For sex, like religion, is something very intimate, and it is difficult to be sure that words may not do as much harm as good. Two points, however, seem to stand out clearly: (*a*) that the policy of extreme reticence, for the most part adhered to in the past, has not had very brilliant results; and (*b*) that if there is to be in the future more definite sex-instruction in schools, we are beginning at the right end by educating ourselves.

We are told that our ancestors got on very well without any study of sex, but we have our doubts. Moreover, new conditions require new methods; a knowledge of hygiene is more imperative now than it used to be, and it may be the same in regard to sex. It is a note of the new age to face difficult facts with precise knowledge. Science is for life —the control of life.

We are told that just as it is not good for plants to have their roots inspected, so it is not well to probe into the physical basis of love. There is a mysticism and a sacredness in human love which no one would willingly jettison. But the danger here is not in the scientific study of sex, it is in not being scientific enough. The view suggested by a

materialistic physiology, or by eugenics without eupsychics, or by a grotesquely exaggerated Freudian psychology, may be no better than ignorance and perhaps worse, but we are not shut up to these obviously partial views. We need not be blown about by every wind of doctrine. Just as the wise botanist has the reward of his labours, for the Dryad comes back to the tree, so the careful student of the roots of sex will find love to be a fairer flower than ever—with a new mysticism and a new sacredness.

One reward comes soon if we study the biology of sex in some more or less severe treatment, such as Miss March's "Towards Racial Health," or Dr. F. H. A. Marshall's "Physiology of Reproduction," or "Lectures on Sex and Heredity," by Professors Bower, Graham, Kerr, and Agar, or "The Evolution of Sex," by Geddes and Thomson. The reward will be having the atmosphere of the whole subject cleared. One is sure to get away from any *mauvaise honte,* from any suggestion that we have here to do with anything "funny" or "risky" or indecent. There is doubtless a humorous side to some aspects of courtship and marriage, but the difference between that and a smutty story is like the

difference between a sunny meadow and a sewer. One likes what has been recorded of Lord Kitchener's severe treatment of the sex-jester.

In this connection we venture to quote a paragraph from the late Professor W. M. Bayliss's "Principles of General Physiology" (1915), one of the biggest biological books of recent years: "It is indeed greatly to be regretted that the sexual process should have become the subject of unseemly jesting. Of course, incidents of real humour may arise in any connection, without detriment to its essential solemnity, as witness the great art of Shakespeare. But I feel compelled to state my belief that much mischief is done by the habit of looking upon anything related to sex as, in itself, a matter for jesting, apart from any real humour. Possibly, the excessive secrecy and reticence maintined on the question are much to blame, and there is no doubt that the wider teaching of a proper physiology in schools will have a good effect in this direction. The almost universal ignorance of matters of the most vital importance to the community, as well as to the individual, is scarcely less than amazing. It is much to be hoped that in the future the sexual process will be looked upon as something essentially beautiful and good. The reader

will surely not need to be reminded that the love of man and woman has been the motive force of many of the greatest and noblest deeds in the world's history." This is well said, but the reference to proper physiology in schools raises the regret and reproach that so many school text-books on the subject, even Huxley's, still continue to treat the living organism as if it were sexless. There is no chapter on Reproduction.

Some clear knowledge of the physiology of sex —on the part of those who desire clearness—is useful in lessening pre-occupation over the obscure, for all such brooding wastes time and makes worry. But we think there is a deeper value. As it seems to us, man has normally strong sex-impulses, but only vague sex-instincts. Among some humble creatures, such as insects, there are often very definite reproductive instincts of a complicated sort, which sweep their possessors through an intricate routine of courtship, mating, and preparation for the young—often never seen! Now, man is at the opposite pole, for his reproduction and sexual instincts remain generalised. We have, in regard to sex-functions, very little instinctive knowledge of what the various phenomena mean, or of what is normal or of what is to be carefully avoided. Thus,

one may slide into bad sexual habits without being at first well aware of what is happening, or on the other hand, one may make oneself miserable without good reason.

Perhaps it might be said that if precise awareness of the significance of the normal and of the insidious beginnings of the abnormal were of survival value, it should have been part of the instinctive inheritance of the race. But there are several fallacies here. It is enough to say that on the "big-brain line of evolution," the place of inborn instincts is more and more taken by intelligent educability. This is a great improvement, but it carries with it a tax. Because of this tax there were in olden times various initiations and disciplines connected with adolescence. The problem is to evolve modern analogues of these.

Perhaps it may be said again that if the sex-instincts are generalised in man and very deep down, it cannot be wise to meddle with them much. And with this old-fashioned view we are disposed to agree. All that we are pleading for is a scientific recognition of the significance of these instincts and of their blunt vagueness—a vagueness which makes it impossible for us to trust them, which makes it desirable for those whose sex-life is stormy

to supplement "nature" by "nurture," hereditary endowment by education. We strongly suspect that the devotees of psycho-analysis are doing harm by bringing into everyday life and conversation a method which has its place in the laboratory and the hospital. It is not part of normal experience, we take it, to have the deep under-currents forced to the surface. The very depth at which they normally flow shows that their safe operation is *through* the upper currents of intelligently and rationally controlled life. Valuable as a scientific and therapeutic method, psycho-analysis in everyday life is threatening sense.

To a little book on "Sex" in the Home University Library we have appended a representative bibliography and another will be found at the end of Miss March's admirable "Towards Racial Health." We venture to suggest (1) that there is little value at present in reading more than two or three books on the subject, for the science awaits the discovery of new knowledge; (2) that those books are to be avoided which arouse sex-appetite; and (3) that there is no warrant for ordinary students wading into the pathology of the subject. As regards our ordinary internal functions, we know that it is foolish to read books on heart-disease and kidney

troubles; in regard to sex likewise the less pathology we read the better.

Love is the flower of which sex is the root, and, to be quite frank, what we all need is a profounder study of the flowers; then we need not bother so much about the roots. A lifetime is not too long, Comte said, for a man and a woman to get to know one another well and to learn to love one another worthily; and we think that some discipline in the art of loving worthily would do most of us more good than a course of reading on "Sex." We do not mean that we should think of eugenics less, we mean that we should think of eupsychics more.

If a student getting old may offer counsel to students who have the adventurousness of youth, we would lay emphasis on three points:—

(1) There is a time to embrace, we are told, but there is also a time to refrain from embracing, and both are normal parts of our life. But while passion is imperious enough at times, we cannot share the view that sex is such a dominant factor in ordinary life as some modern specialists maintain. The organism is a unity, and the sex-life is inextricably mixed up with the rest of our life. No doubt some people are born with a great capacity

for loving, while others inherit a sex-strand that is peculiarly liable to kink, or knot. In both cases, we take it, it is undesirable to attempt to isolate or analyse apart the sex-life, as if it were in some way antithetic, and not an integral part of a unity. After all, our inheritance is more than a bundle of discrete factors (as even the extreme Mendelians now admit); it is an organism—a life. The botanists tell us of plants which are always interpenetrated by a fungus, which works through root and stem, even into leaf and flower; and such a duality is an image of the life of anyone who becomes obsessed by the fleshly side of sex; our point is that one of the safeguards is refusing to allow the isolation of the sex-life. Let us cultivate the flower, and the root will not disappoint us—in the garden of the spirit.

(2) Even robust natures are sometimes troubled for years by obscene sights they could not help seeing or stories they were unlucky enough not to be able to avoid hearing. The scientific atmosphere sterilises some of these insidious germs, and others are elbowed out by what is wholesome; but perhaps it is worth saying that there is some cure for the infection in humbly trying to think largely of sex, to think of it in its social or racial aspects, to

think of it as the organic basis of one of the strongest motive-forces and lasting joys in the world.

(3) It is worth our while to give some time to what may be called the comparative study of courtship, or in other words, to seeing sex in the evolutionary setting. For is it not great encouragement to see that in the course of evolution, physical fondness has had added to it psychical sympathy, that the roots in the flesh, which are fundamental, give rise to finer and finer flowers of the spirit, which are supreme? If we study certain birds, such as grebes, we find an elaborate courtship ceremonial which establishes an "emotional companionship." The import of this is that it afterwards helps to keep the birds joyously together in work and play. This sublimation of fondness into love is perhaps the chief lesson of the study of the evolution of sex.

§ 10. Married Life

The three sails of a happy married voyage are organic fondness rising into æsthetic attraction, some measure of intellectual sympathy (which does not necessarily include belonging to the same political party), and some capacity for working together

at something—if not at the business of life. This companionship in work is a great source of happiness and it is oftenest enjoyed by those who have considerable struggle for well-being. But while these three sails make for success, the voyage is sometimes made with two or with one. Those who make it with none can hardly be said to be more than legally married.

Speaking for men, we must agree with Bernard Shaw's rather terrible half-truth that marriage is popular because it combines the maximum of temptation with the maximum of opportunity. To men at least there is great danger of yielding overmuch to the desires of the flesh, with consequent evil effects on health as well as on spirit. A respectable married man sometimes becomes very monogamously licentious—a nemesis of letting lust swallow love.

The tree of love has its roots in our "animal nature," and though they are not to be ashamed of, they will usually stand a good deal of root-pruning. But the tree is very incomplete if it does not raise branches high into the sunlight, where they may bear the flowers and fruits of the spirit. It is a great pity when love does not rise off the ground.

We do not agree with the gibe that married life

becomes sooner or later retrospective, a tomb of dead joys. That is the punishment of not hitching the sex-wagon to a star. Auguste Comte struck a finer note: "For two beings so complex and so diverse as man and woman, the whole of life is not too long for them to know one another well and love one another worthily." This will be easier when health is cherished as the prize of gifts.

§ 11. Birth-Control

No one who takes seriously the problem of the health of the community can blink the subject of birth-control, which touches so closely the welfare of mothers and children alike. By birth-control is meant the employment of more or less artificial, mechanical or chemical ways of preventing conception, that is to say, of preventing the development of the ovum from beginning. The question must be faced in a broad-minded way.

In the first place, we think, it is for the medical expert to say whether contraception is practicable, without detriment to health. It is idle to ignore the fact that many medical experts have expressed their conviction that there are practicable and harmless methods of contraception.

In the second place, we must brush aside the bogey of the "artificial." The whole of human life is interpenetrated by the "artificial." We keep people alive artificially; we restore the unconscious "drowned man" artificially; we replace injured tissue artificially; we counteract thyroid deficiency artificially. Why not use artificial means to prevent an individual life from beginning? It seems to us that all this line of argument is insincere. But when an individual life has begun, it is a different proposition; the individual life is sacred.

To call birth-control immoral seems to us a misunderstanding of terms. When means are used deliberately, with reference to the welfare of mother, child, and community, to prevent sex-union from implying parentage, it may be a mistake, but it cannot be called non-ethical. It is obviously more ethical than saying: Damn the consequences. That the methods may be used to evade the consequences of immoral conduct is quite true, but an immoral use may be made of any scientific discovery.

Let us state, as fairly as we can in brief space, the most cogent objections we know against the use of contraceptive methods.

(1) It has been urged that the moral fibre of

many a stock has been engendered by the struggle necessitated by large families. But this is a proposition difficult to prove or believe; and against its allegation must be weighed the misery and hopelessness wrought in many women through over-frequent births.

(2) It has been urged that high-minded people should avoid preventives, since their duty is to practise more self-restraint. But there are limits to the possibilities of self-restraint for ordinary mortals; and the edge is taken off the pious opinion by the fact that the greater the restraint, the surer, in many cases, is conjugal intercourse to be followed by conception. Self-restraint is a virtue to be aimed at, but it is no solution of the problem of avoiding too large a family!

(3) It is maintained by some, and not without reason, that chemical methods of contraception imply a gross materialisation of what should be guarded from any such intrusion. Artificially to prevent the natural consequences of an act is a common practice in human life, as when we use antiseptics to kill off intrusive germs; but it is a different matter to prevent an ovum from developing. It must be admitted that there is always an element of danger when the mechanical is sub-

stituted for the moral, yet we would deny with emphasis that the use of contraceptives is "bringing human love down to the level of the farm-yard." It is a deliberate scientific method of preventing the beginning of a new individual life, in order to avoid evil consequences to the health of the mother and welfare of the family. It may be a *pis-aller;* there may be a tax to pay; but it does not necessarily involve any slackening of moral fibre or loss of fineness.

(4) It is often urged that the use of contraceptives will favour "free love," since it allows of the evasion of parentage. Cases are known where this has happened, and the risk must be admitted and faced. One should remember, however, that it is not a good policy to legislate for extremes. The non-moral types, who would use contraceptives to avoid the parentage that may follow adultery or fornication, cannot be legislated for by making the use of contraceptives illegal, as abortion is. The people to be most thought of are the mothers of large families, especially when in straitened circumstances.

(5) Professor Pembrey, a distinguished physiologist, has severely criticised the use of birth-control methods as a degenerate evasion of a virile struggle

for existence. We respect his physiology more than his argument; for when he says that the practice of artificial birth-control degrades woman both physically and morally, he is merely expressing an opinion, which cannot at present be verified. Individual cases do not prove much, but it would be easy to give instances of birth-controllers who show no hint of degradation! We wish to press the point that even with great conjugal restraint—easier in a large house than in a small one!—the succession of births is often too rapid to be desirable. For it tends to depress the health of the mother, it gives the other children less chance, it makes against family happiness, and it intensifies the struggle beyond useful sifting. Of course we do not mean by "birth-control" having no children at all, but merely the deliberate adjustment of their number to the conditions of the case.

Professor Pembrey suggests that birth-control may be a blessing in disguise by assisting in the elimination of the types who practise it, "types in whom physiological processes are inadequately balanced." But it appears to us that it will be very difficult to prove that this lack of balance is a general feature of those who practise birth-control. They have had as many children as they can hope

to care for well—for the time being at least; or they have had as many children as the mother's health, in the widest sense, will stand.

In fairness, however, we wish to quote a short paragraph from Professor Pembrey, for the difficulty of the problem must be admitted by all. We would preface what he says with the note that those who advocate methods of "birth-control," because they see no other way out, are not in normal cases advocating more than a *restriction* of parentage.

Professor Pembrey writes: "The modern crusade of 'birth-control,' supported though it be by some biologists, is not based on biological principles or the theory of evolution. It involves the view that the environment is more potent than the stock; it ignores the value of the struggle for existence and the survival of the fit. It is no evidence of self-control, sacrifice, and a yearning for the higher life, but a desire for luxury and a loss of belief in the capacity of the offspring. Its practice degrades women both physically and morally, for the production and rearing of children will always be the biological test of her womanhood and her greatest service to the State."

We would point out, however, that a frequently recurrent trend in organic evolution has been to-

wards a reduction of the family, and that it has not failed of its reward. Moreover, there is not the slightest reason to fear that birth-control will do away with opportunities for "struggle"; the hope is of lifting the struggle away from a depressing scramble around the platter of subsistence. Our view is that a diminished birth-rate, within limits of safety, will tend to improve the health of children and mothers, and may tend to substitute quality for quantity. Better forty millions healthy and vigorous and joyous, than sixty millions riddled with bad health, weakness, and depression. Professor Pembrey speaks of motives, and we have admitted the danger that contraceptives may be used to evade the consequences of self-indulgence and canine casualness, but we know that it is inaccurate to suggest that the motives behind the control of births are necessarily selfish or prompted by a desire of luxury.

Let us give more consideration to the positive side. There can be little doubt that a diminished birth-rate will tend to improve the health of both children and mothers. There will be a price to pay, but birth-control will probably tend to make life less anxious, more joyous, with greater opportunities for fineness. If along with advice as to arti-

ficial birth-control, there could be given by wise physicians some gentle counsel towards living at a higher level, there might come some exemption from the tax on a method which evades natural responsibilities.

If one thought that birth-control necessarily meant a great increase of what may be euphemistically called "free love," one's misgivings would of course increase; but is there much warrant for the supposition? If one thought that birth-control was going to relieve a large body of the people from either the struggle for existence or the endeavour after well-being, one's misgivings would of course greatly increase; but there will be abundant opportunity for struggle and endeavour even when birth-control becomes much more general than it now is. Already, according to the statisticians, birth-control is responsible for a large fraction (about a half) of the diminution in the birth-rate. But we confess that we do not know how they know!!

The most serious objection that we know of to the practice of artificial birth-control is that it would be least used by the thriftless and feckless, and that this would tend to a proportionate increase of these undesirable types. But this is what

has been going on for a long time apart from birth-control, and there is something to be said on the other side, namely, that the possibility of marrying without the risk of having a large family would encourage marriage and earlier marriage, and thus favour the proportionate increase of thrifty and foreseeing types.

It seems to us that artificial birth-control will further increase the independence of women, and their opportunities, besides maternity, of effective self-expression. Finally, we believe that the diminution of the birth-rate operates against war, which has been so often the Nemesis of an increase in the population beyond the limits of stability.

On a question like this, with relatively few data and much surmise, we have no wish to be dogmatic. Perhaps the objections are stronger, perhaps the tax is heavier, than we know. But when we look around and see how much bad health and sub-health is brought about by too many births in rapid succession, we do not, speaking for ourselves, see any way out save in *such birth-control as the medical experts will not disapprove of.*

On the other hand, whether birth-controllers or dependents on "Providence" ("whenever God sends a mouth, He sends something to fill it"),

must we not all agree that if we lose the chivalry and tenderness of lovers, the joyousness of the spring-time of the heart, the adventurousness of early marriage, the delight in children with whom we are young enough to sympathise, we are missing the most fragrant flowers of life.

§ 12. Ageing

Sooner or later the curve of life normally shows a downgrade, and the success of the quest for health is signalised by the prolongation of the period of mature strength without any marked indication of ageing. It is normal that an age of three score years and ten should be reached—and reached without pronounced senescence. There are several familiar ways in which men fail to reach this desirable evening time of life. They may be cut off by an accident; they may be killed by a microbe which finds them in a non-resistant phase; they may be the victims of a malignant growth—still very mysterious; they may be poisoned by over-eating, over-drinking, or over-anxiety; they may be weakened by something seriously deteriorative in surroundings, food, and occupations; or in rare cases (like the worker-bees among animals) they

may kill themselves prematurely by sheer overwork. It will be noticed that most of the causes of dying before one's time are avoidable.

The reason for ageing is the accumulation of wear and tear results in the tissues. Although there are recuperative processes always going on such as rest, sleep, and change afford, the recuperation becomes less and less perfect in all animals that have a body worth having. Sooner or later rejuvenescence is mastered by senescence. It does not seem to be the living matter that grows old, it is rather the furniture of the living house.

In ordinary ageing the bones become lighter and less resistant, some of them breaking easily. The muscles become weaker and stiffer, hence the old man's stoop. The nervous system becomes slower in its responses and less forceful. The heart beats less vigorously and the arteries become less elastic, whence the familiar saying "a man is as old as his arteries." A breaking down of an artery in the brain may spell "a stroke." The general integration of the body is "not what it once was"; the parts begin to fail to answer to one another's call.

How admirable the well-known picture in Ecclesiastes:

"The mind and the senses begin to be darkened,

the winter of life approaches with its clouds and storms; the arms, the protectors of the bodily house, tremble; the strong legs bow; the grinders cease because they are few; the apples of the eye are darkened; the jaws munch with only a dull sound; the old man is nervously weak and startled even by a bird chirping; he is afraid of hillocks; his falling hair is white as the strewn almond blossoms; he drags himself along with difficulty; he has no more appetite, he seeks only for his home of rest, which he finds when the silver cord is loosed or the golden bowl is broken."

It is not possible to draw any strict line between normal ageing or senescence and the exaggeration of this which we call senility. But the distinction is clear enough: we speak of senility when the disintegrative processes markedly affect the unity of the organism. In senescence there is weakening and slowing; in senility there is involution and rotting.

One of the large problems of health is how to avoid senility. The normal end is a weakening of foothold till some environmental gust or an intrusive microbe brings sleep. The abnormal end is a disintegrative deterioration: how is this to be avoided?

(1) It is good advice to avoid bad debts due to bad habits. Metchnikoff said that the two poisonings that age us most are alcohol and syphilis. Among the other bad debts are those due to over-indulged sexual appetite. Every one has great theoretical pleasure in the old maxim: "Avoid the things that are harmful and be moderate in all things."

(2) A simple common-sense piece of good advice, often ignored, is to have hobbies or enthusiasms to fall back on when ordinary work has stopped. Cases are tragically frequent of men who have done a good day's work, yet do not survive a year of leisure. This is sometimes due to their having become "the slaves of habit"—kept agoing sometimes by the momentum of routine. But there are other cases where men die because they had nothing else to do! In no department of life so much as in his own physiology does the ordinary man deny the Reign of Law. He retires from a life of hard work without an interest to occupy him, and yet expects to live. "Shall gravitation cease when you go by?" There are animals that become stiff and stark when they are lifted off the ground, because it is through their feet that they normally receive the news that keeps them awake;

so it must be with a man who is suddenly insulated from his normal contacts and has no other interests ready to replace them.

(3) Preventive measures are all very well, but the avoidance of senility must largely depend on positive rejuvenescence. Those growing old should seek not quiet but change, not isolation but fresh experiences, not detachment but new interests. Some of those we have known who have remained longest young have been men who sought out new adventures after three score years and ten. Let us join the society of the old and bold—and, failing that, the golf club.

On the other hand, it is not contradictory to what we have said of adventure, to offer the old-fashioned counsel that there should be a deliberate return to fundamentals—the walk, the open air, the simple delights of the country.

No doubt ageing must come. "And so from hour to hour we ripe and ripe, and then, from hour to hour we rot and rot, and thereby hangs a tale." The whole point is that while we *must* "ripe and ripe," there is no inevitable reason why we should "rot and rot." We must all die sometime, but we can make certain what we shall *not* die of. In various ways, such as we have ventured to sum

up somewhat prosaically, we may greatly increase our chance of being young—fairly young—when we die.

In Conclusion

Looking back over the trajectory of life, from the vita minima of the embryo to the vita minima of old age, we are impressed with the importance of health in every arc of the curve. It does not seem to be too much to say that if we would make the most and the best of each period—childhood, adolescence, maturity, and ageing—we must seek after health with all our heart. Not that we should become valetudinarians and pursue health directly, in season and out of season. The moral is rather to covet the best gifts and health will be thrown in.

CHAPTER V

THE HEALTHY MIND

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CHAPTER V

THE HEALTHY MIND

We cannot say too often: *mens sana in corpore sano,* the healthy mind in the healthy body. For these are at least two complementary aspects of life; and some thinkers would say that they are the two great entities of life: the mind and its body, like the musician and his instrument. Whichever view we take, the mental life and the bodily life are both realities, thinking as much as eating; and the ideal is that both should be healthy. In working towards this end, the interdependence of mind and body must be recognised, for even if we feel quite sure that the mind is an independent reality, capable of conquering and transcending the body, we must admit that in everyday experience it is thirled to the body, and is influenced by the ills our flesh is heir to. Similarly the body can be depressed or invigorated by the mind. "A merry heart is the life of the flesh."

§ 1. The Relation of Mind and Body

For two thousand years at least, men have pondered over the relation of mind and body, and it remains an unsolved problem. Perhaps it indicates some limitation of human intelligence that we seem to make little progress with the question. Perhaps we have not learned to put the question in the right way.

The Mechanistic View.—According to one extreme school, man is a very intricate machine that makes negligible sounds which we call consciousness. Mr. Hammond constructed an ingenious "dirigible dog" with selenium eyes and an internal electromotor with automatic steering gear. When the visitor to the dark room where the "dirigible dog" was kept flashed the light of a lantern into its highly sensitive eyes, the contraption made for him on its wheels, and as the light moved to avoid the awful "it," the steering gear was correspondingly altered. The "dirigible dog" chased the visitor around the room!

Now the suggestion of an extreme school of physiologists is that a real dog is just like this "dirigible dog" raised to the *n*th power of intricacy and efficiency. It is true that most of these ex-

tremists allow that the real dog has feelings and mental images and so forth; but they do not regard these as more than non-influential accompaniments, like the bubbles on the surface of a turbulent stream. They are there, these mental processes, *but they don't count.* They form a by-play; they are "epiphenomena"; they may be compared to the safety-valve whistle of an engine. The wheels of life go round because external and internal stimuli of a chemical or physical nature activate or pull the trigger of internal "mechanisms"—the pre-established reflex arcs, that is to say the linkages between sensory, associative, and motor neurons, and between the last and the muscles.

The reason why we reject this view is that it does not cover the facts. It is true so far as it goes, but it is inadequate. We cannot give an account of the behaviour of *our* dog without crediting it with a mental activity that counts. Our dog has feelings, memories, purposes that are actually operative. It can enregister experiences within itself in a way that is beyond any imaginable machine, and it alters its behaviour in the light of, or under the influence of, these enregistrations. We see the creature building-up associations, e.g. between a certain sound and a certain action, which

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are very important in its daily life. We have only to mention a person's name to evoke an extraordinary display of emotion. From half a mile off we point to the railway station and say quite quietly: "Bluff, your mistress is coming home by that train"; and off goes the dog like an arrow. We believe that it differs *in kind* from any dirigible dog.

Only by verbal jugglery is it possible to conjure mind out of matter, as the physicist defines matter; or a purpose out of a protein, as the chemist defines protein. And we believe that mind and purpose are activities which are actually operative in animal behaviour. Ideas have hands and feet, as Hegel said.

Even for the body as body we do not think that the descriptive formulæ of chemistry and physics are adequate. There is certainly an indispensable and illuminating chemistry and physics of the living body, but they do not suffice for the description of the orchestration of activities into a harmonious bodily unity. We do not know of any one complete vital process of which an adequate chemico-physical description can be given; but we do not press that point so much as the general fact that the organism is a unity in a sense that is not true of a machine.

When we pass from the everyday life of the body to the process of development, such as "the minting and coining of the chick out of the egg," which has so much impressed observers from Aristotle to Harvey, we feel an increasing difficulty in being satisfied with purely chemico-physical (believed to be reducible to mechanical) description. And if we are asked what we wish to add—some mysterious "vital force" for instance?—we would answer that we wish to recognise certain at present irreducible qualities of the living creature. Prominent among these is the organism's power of enregistering experience and profiting by it. In some way, that takes us far from the machine, the living creature is a "historic being," that is to say, it registers the past so as to influence the future. The living creature can "learn" at many different levels. The past remains within it, living and active, even at levels where there is no memory in the human sense. We must not pursue this further, our point is simply that the description of a living creature's activity requires special biological formulæ, such as this capacity for enregistration, or the capacity for reproducing, or the capacity for developing.

When we study the behaviour of higher animals

like apes and elephants, dogs and horses, the transcendence of the vital over the mechanical becomes clear, since we cannot describe what they do without crediting them with feelings and intelligence. Still more is this true when we pass to man, for a machine cannot have a theory that it is a machine!

The reason for dwelling on this question is that no one is likely to take healthy-mindedness very seriously if he has come to the conclusion that the "mind" does not count. If man is no more than a superlative extension of the mechanism of Hammond's "dirigible dog," why need any one trouble about the abstraction called "mind"?

§ 2. Is the Mind a Distinct Essence?

A very different view is that of those who regard the mind as a distinct essence, with a life and unity of its own, and with a nature quite different from the matter and energy (or matter-energy) which is measured and described by the chemist and physicist. The mind plays on the body as a musician on his violin. For making music they are necessarily correlated, yet they can be thought of apart. This is the dualist view, that there are two realities, the mind and the body, *both essential.*

The mind needs the body to be its intermediary

or effector in acting on the outer world, also to be its system of scouts, bringing in tidings. The mind influences the body and is influenced by it, just as the musician brings about changes for good and ill in his instrument and may at another time thrill to it.

We may take the late Professor Jacques Loeb as a representative of the convinced mechanists, and Professor William MacDougall as a representative of the convinced animists, who believe in a mind incommensurable with the metabolism of living matter. To begin with we should keep this question separate from that of a "soul" which can survive the dissolution of the body. Many believe in the distinctiveness of mind who do not believe in the immortality of the soul. It should be noted that if any one identifies his mind with the "spark of divinity" that is in him, he must be able to give some good reason why he should not do the same for his dog, as indeed many of our forefathers did. It is conceivable, however, that the "soul" is a higher synthesis, a "tertium quid," as high above ordinary mind as that is above physiological irritability. It is possible that this "soul," if real, as distinct from mind, is less in the trammels of the body.

§ 3. Body-Mind and Mind-Body

There is another way of looking at this difficult, yet momentous problem. It is called the *monistic* view, which regards the living creature as a unity with two aspects. Using chemico-physical methods we study the body-aspect; using bio-psychological methods we study the mind-aspect. More accurately, the bio-chemist and the bio-physicist (and the biologist too) must at certain times and for certain purposes study those aspects in which the living creature appears mainly a body, while the biologist and the psychologist must at other times and for other purposes study those aspects in which the living creature is more of a mind. The two aspects of the one living reality are body and mind, metabolic and mental, physical and psychical, ponderable and imponderable, biosis and psychosis. But since the use of these contrasted terms brings us back to a dualistic way of looking at things, it is better to say that in the one aspect the organism is a Mind-*Body,* the objective matter-energy aspect being more obvious, while in the other aspect the organism is a Body-*Mind,* the subjective psychical aspect being more obvious. The two aspects are as inseparable as the silver and

gold sides of a shield, the convex and concave surfaces of a dome, the outer and inner of a foam-bell. In our mundane experience we do not know pure Mind or pure Body; and these may be merely *false abstractions*. What we know is at once Body-*Mind* and Mind-*Body*.

When we are studying digestion, the aspect is plainly for the most part a question of metabolism, yet everyone is familiar with the fact that good news helps the digestive process. Thus what we study is Mind-*Body*. When we are studying the process of reasoning, the aspect is plainly for the most part psychological, and yet every one knows that indigestion affects our conclusions. So what we are studying is Body-*Mind*. Here then is our justification for spending so much time in trying to get a little clearer as to one of the limiting problems of human intelligence—a problem in regard to which mankind has made little progress in two thousand years.

§ 4. Two Certainties

Whatever be the most accurate way of thinking of the relation between Body-*Mind* and Mind-*Body*—which some would call Bio-psychosis and

Psycho-biosis—two familiar certainties emerge. In the first place, both aspects are *real,* the inner subjective life as much as the outer objective life. In the second place the two aspects or realities are inseparable, except for the temporary purposes of analysis. As we personally favour the monistic view, we do not speak of the close interaction of mind and body, for this seems to us to swing back to the idea of two separate essences, body and mind. We prefer to say that the organism is so close a unity that we always see it either as Body-*Mind* or as Mind-*Body.* But if anyone prefers to speak of the facts as illustrating the interaction of Body and Mind, there is no reason why he should not do so. The facts remain the same whatever be the theoretical frame.

The facts are of fundamental importance. Clinical biographies, as they are called, show how a man's life of thought and feeling may be influenced by some defect in his eyesight or in his digestion. A clot on the brain, due perhaps to the bursting of a small blood-vessel, may obscure the whole intellectual horizon; through deficiency in the activity of the thyroid gland a child remains arrested mentally as well as in its bodily development; in the various stages of chloroforming there

is an inhibition of level after level of mental capacity; in the various stages of intoxication there is gradual loss of mental control till delirium may set in. On the other hand, the conquest of the "body" by the "mind" is also a fact, though, unfortunately, less familiar. Fatigue sometimes vanishes like magic before good news; resolution occasionally banishes disease; suggestion cannot heal a lesion, but it can work curative wonders. Many other examples might be given of the unity of the organism, or, in other terms, the interaction of body and mind, but these may serve in the meantime. It should be noted that the unity is by no means without its discords, in other words, the interaction is not always obligatory. Thus the sickly may have a conspicuously healthy mind and the vigorous may be foul at heart. In the case of the insane it is usual to distinguish those in whom the cerebral aspect is prominent from those who are more markedly mental—another instance of the utility of the Mind-*Body* and Body-*Mind* formulation.

§ 5. The Nervous System

If we are to appreciate the health of the mind and its loss of health we must give some study to

the nervous system, but only a few points can be noticed here. We would refer the reader to Professor Fraser Harris's "Nerves" in the Home University Library.

The nervous system includes (*a*) the brain, sheltered by the skull; (*b*) the spinal cord running down the protective neural canal formed on the dorsal surface of the backbone; (*c*) the nerves that come out from both, most of them specialised either as motor nerves (commanding muscles and glands) or as sensory nerves (receiving stimuli from the outer world or from the recesses of the body, though a few are "mixed nerves" with some fibres that carry impulses outwards and others that carry tidings inwards); and (*d*) the sympathetic system, that is beyond our control, a chain of small centres or ganglia, extending along each side of the body-cavity and giving off nerves to internal organs and blood-vessels.

What facts in regard to this intricate nervous system are most important when we are considering the health of the mind?

The general principle of the nervous systems in all animals above those that are very simply built is the *reflex arc*. What does this mean?

(*a*) There are sensory nerve-cells or neurons

which receive tidings from the outer world and from important organs of the body. They might be compared to scouts that gather information. In backboned animals they are for the most part situated in the spinal ganglia on the dorsal nerve-roots that issue from the spinal cord. Their fibres extend to endings in the skin or in internal organs. The olfactory sensory neurons which form patches on the lining membrane of our nostrils illustrate what is very rare among backboned animals, that the sensory neurons remain superficial; but among backboneless animals, such as earthworms, this is the usual position.

(*b*) In typical cases a fibre is continued from a sensory neuron into the spinal cord where it divides into two. The fine endings of the branches come into intimate association (called synapsis) with the fine branches of associative nerve-cells or neurons. These might be likened to General Head-Quarters (G.H.Q.), where the reports of the scouts are received and considered. The associative cells get other names—connecting, communicating, and internuncial; their function is to intermediate between the receipt of news and the issuing of orders. One associative cell is usually linked to another, and that to another, so that one stimulus may acti-

vate several different associative cells; and among these, especially in higher animals, there may be some that are able to inhibit further activity. This is of great importance for it spells control. A higher animal differs from one lower down in the scale of being in having a far greater proportion of associative nerve-cells. Thus a bird excels a fish of the same weight, and every one knows that it has more of a "mind" and a much more controlled life. Birds can inhibit their swallowing reflexes to a degree impossible for most fishes.

(*c*) The next link in the reflex chain consists of the motor nerve-cell, which receives stimulation from associative neurons and gives off a fibre along which a commanding impulse passes to a muscle or to a gland, provoking the former to contract and the latter to secrete. The motor neurons might be compared to Executive Officers who give orders to the "men" who do the work. A motor nerve-fibre forms a beautiful branching or "arborisation" on the surface of a muscle-fibre, and in some way not understood the thrill passes from the one to the other. The nature of the nerve-impulse remains obscure; it is some rapidly propagated molecular agitation. The rate differs in different types; in man it is about one hundred feet in a second.

(*d*) The muscle-cell that contracts and does work is often called the effector; and thus, using the first letters of the four words—Sensory, Associative, Motor, and Effector—we may write down S-A-M-E as a convenient graphic formula for a reflex action, such as we illustrate when we draw our finger hurriedly back from a hot cinder. That this and many another reflex can be *inhibited* is well known. If circumstances arise that make it highly desirable not to allow the natural reflex to complete itself, it can sometimes be done. Thus a sneeze or a cough or a swallowing gulp can be suppressed; which means that associative cells not in the direct circuit have been able to inhibit the natural sequence. How they do so is a difficult question.

To our simple picture we must add two or three touches. Thus in ordinary cases the linkage S-A-M-E is not between four individual cells, but between four groups of cells, the principle remaining the same. Again it is very usual that the reflexes themselves form a chain, one calling up the other, as it were. Thus in swallowing, one reflex movement is obviously followed by another, and that by another. Similarly in a paroxysm of coughing or a burst of uncontrollable sneezing, it is not

necessarily one and the same S-A-M-E that is operative all the time.

The linkages in a reflex arc are established in the course of early development, and form part of our inheritance. But in the course of life, in work and in play, we establish new linkages of a somewhat similar nature, but not inborn. These are known as dexterities, as in using a tool or riding a bicycle. When the activity is frequently repeated, it becomes easier and quicker—"automatic" as we say. It becomes easier for the nervous impulses to travel along one particular line than along any other. To use a metaphor, we establish a line of least resistance. Practice makes perfect, and this is called habituation—a better word than "habit" which is used in too many senses. A habituation thus consists of a succession of reflexes, which we might represent as: S-A-M-E; s-a-m-e; *s-a-m-e;* and so on. The one link almost inevitably evokes its successor, and this is at once the strength and the danger of "habits." What begins like a cobweb ends like a cable.

Some realisation of the intricacy of the nervous system with its continual receipt of tidings and issuing of orders, with its storing and combining of impressions, with its guidance and control, may be

useful in suggesting the desirability of avoiding what may clog and dull the subtle organisation. The busiest telephonic "central" has an easy-going and simple activity compared with man's nervous system. Moreover, we have to keep in mind that it is permitted to man and to all the higher animals to do what could not be allowed in a telephonic exchange, namely, to prevent questions from receiving their most natural answers (inhibition) and to take initiatives in the way of giving orders (experimenting). Even when man does not rise to any height of intellectual effort, there is hard work to be done in the nervous system, and the strain of playing a good game of tennis or the like may be not less than that of thinking out a problem. Hence the importance of keeping the nervous organisation in good health—unpoisoned, unworn, and yet in active exercise. One of the first things a physician does to an unknown patient, who comes to consult him, is to examine his reflexes, even very simple ones like the "knee jerk." If the response is a failure the physician knows what else to expect.

One of the most important steps in organic evolution occurred some millions of years ago when certain arboreal animals related to the Tree-Shrew (Tupaia) began to show a great advance in the

front part of the fore-brain or cerebral hemispheres. There came about—no doubt with sublime slowness—a reduction of the part of the cerebrum that received tidings from the nose, and an increase in the part that received tidings from the eyes. The nose-minded mammal was becoming more and more eye-minded. A part of the brain, called by Professor Elliot Smith the neo-pallium, began to become prominent, and its gradual increase can be traced through the Spectral Tarsier, some of the half-monkeys, or lemurs, the little marmosets, the New World monkeys, the Old World monkeys, and the apes, the climax being in man. It is an area not only for receiving tidings from eye and ear, but for the control of delicate manipulations and for the focussing of attention. Now this neo-pallium is part of the convoluted cortex of the cerebral hemispheres, in which all our higher faculties have their seat, and towards the quest for health, it is important to realise something of the intricacy of this part of our organisation. Professor G. H. Parker tells us in his "Biology and Social Problems," that the human cerebral cortex varies from one and a half to five millimetres in thickness and covers an average of 2352 square centimetres. It weighs about 658 grammes, but

the bulk of this consists of a supporting scaffolding of connective tissue and of the blood-vessels which bring nourishment and oxygen and take away waste and carbon-dioxide. The nerve-cells and their fibres, which form the essentially important part, weigh only about 13 grammes, about 2 per cent. of the total. Yet this half-ounce or so, representing about $\frac{1}{5000}$ of the total weight of our body, if we weigh a hundred and fifty pounds, may govern the body. All these cortical neurons could be packed into about a cubic inch, just filling a cube whose edge is 2.35 centimetres, and yet they form the seat of our personality which refuses to be limited. The whole convoluted surface of the "grey matter" of our cerebrum would cover 2352 square centimetres if flattened out, about a foot and a half square. Yet this is the seat of all our sensations and memories, feelings and aspirations, thoughts and imaginings. A foot and a half square, and yet in some men it has shaken the world.

Large numbers are rarely very impressive, they are so hard to realise with any vividness; but we cannot forego mentioning that man has about 9,200,000,000 nerve-cells in his cerebral cortex. That is to say, he has in the surface layer of his fore-brain five times as many nerve-cells as there

are people living in the world. The interest of this is that it opens up a vista of possible new departures, for all these nerve-cells have branches which come into close contact with the branches of their neighbours, and while the number of units does not increase after birth, the possibilities of fresh contacts are unexhausted. For another reason it is of interest to mention this immense number of cortical nerve-cells, it gives us an impression of the subtlety of the task of mental hygiene. Man should try to live so that the vast population of neurons may continue to work together in harmony.

In the microcosm of the brain there is division of labour, but while certain areas are particularly associated with particular activities—the eye centre and the ear centre for instance—there are areas to which no special function can as yet be assigned. It is possible that some of these represent more or less virgin soil, formed in the course of that cerebral increase and differentiation, which began so long ago with small arboreal Insectivores. Sometimes there seems to have been a *momentum* in organic evolution. If it be asked how a mass of nervous tissue should be sustained in evolution if not of use and survival value, the answer might be suggested that various structures among organisms

seem to have evolved beyond the range of utility, such as the narwhal's tusk, the giant stag's antlers, the hundreds of "eyes" in a scallop, the scores of luminous organs in some abyssal fishes, a feeler longer than the animal itself, a cumbrous shell like the Tridacna's (used as a holy water font), or the colossal carapace of a giant tortoise. As long as the structure is correlated with some other that is directly useful, and does not become a source of danger, as it did in the Giant Irish Stag, there seems no reason why it should not increase beyond the range of immediate or any utility. In any case there are two facts to be recognised, that there are parts of our brain that have specific functions and others for which no particular use can be indicated at present. As an instance of the former may be mentioned the centre for speech, which Broca discovered in the second half of the nineteenth century. It lies in the inferior frontal convolution of the left side of the brain, and it is connected with the centre for hearing, so that a child born deaf is also dumb.

Another very important fact in regard to the human brain is its prolonged period of growth. Thus, as regards weight, the child's brain is only one-fifth finished at birth, and continues growing

into the second year. What a contrast to the ape's brain, which, as regards weight, is two-thirds finished at birth. To some extent this may be interpreted as meaning that the ape's brain becomes fixed at an earlier age. The child retains for a longer time an open mind.

But along with this prolongation of growth we must notice that there is no increase in the number of nerve-cells after birth. It is indeed a general fact among animals that the nerve-cells of the brain do not multiply after the embryonic period is over. If part of the brain is injured or over-taxed, there may be some vicarious functioning by some other part, but there is no replacement of a worn-out cerebral nerve-cell by another. In other words, while relatively simple cells like those of the outer skin or the lining of the food-canal are replaced as they become worn-out, this is very rarely possible for the highly specialised nerve-cells. The danger of over-taxing a nerve-centre is obvious.

§ 6. Mental and Nervous Troubles

It is impossible to look around to-day without being impressed—sometimes dismayed—by the fre-

quency of mental and nervous disorders. The use of the two words may be convenient to indicate that in some (nervous) cases there is a detectable degeneration or disarrangement of part of the nervous system, whereas in other (mental) cases this cannot be asserted, although the inner life of thought and feeling is obviously quite out of order. A man may cease to be a useful citizen, believing himself for instance to be the victim of conspiracy, although his bodily health is good and although there is no obvious breakdown in the nervous system. That there is a correlation in every case between the psychological processes (psychosis) and the physiological processes (biosis) is generally believed, but it is a fact of experience that in some cases the mental aspect is prominent without there being anything markedly agley in the neural aspect.

The subject of nervous and mental disorder is one of such difficulty that its handling is best left with the expert. As with other intricate subjects, but here more than elsewhere, we must keep carefully to the general outlook of the biologist.

(1) Why is there so much nervous-mental trouble? The general answer must be that man's central nervous system is extremely complex, with its

thousands of millions of inter-related nerve-cells, and that this in itself implies instability and more opportunity of going wrong. Moreover, this very intricate structure is not like a fine watch that one keeps in a chamois-leather envelope in one's pocket; it is a structure bathed in the fluid medium of the body (the blood and the lymph). It is not like a compass on gimbals; it has to share in the bustle of the body. The nervous system is captain. Moreover, as we have mentioned, fatigued nerve-cells cannot be replaced. And again it must be borne in mind that the characteristic peculiarities of the nervous system in the higher mammals—say the neopallium that finds its climax in man—are very much younger, from the evolutionary point of view, than such structures as the food-canal, the liver, the lungs, the heart, and the kidneys. And if younger, then probably more unstable.

(2) It is important, both as regards the individual and the race, to try to distinguish between (*a*) weakmindedness or uncontrolledness, which is manifested from birth onwards and is plainly bred in the bone, imbued in the blood, and embodied in the mind, and (*b*) a nervous breakdown under severe strain. No doubt an easy nervous breakdown under strain may indicate some hereditary weakness,

but it is legitimate and useful to try to make the distinction indicated. Many people who were for ordinary life normal and strong-minded broke down under the strains and stresses and shocks of the war. Moreover, it must never be supposed that normal and abnormal can be distinguished like sheep from goats, or perhaps we should rather say goats from sheep. As Shakespeare says: "The web of our life is of mingled yarn, good and ill together." There is much truth in Darby's remark to Joan: "They're all a little queer cept me and thee, and thee is a little queer."

(3) There is a growing conviction that those who have "a marked family predisposition to serious mental instability or deficiency" should not be parents. The advice of the family doctor should be taken in regard to what constitutes "a marked family predisposition," but in many cases there can be no doubt at all. It should be kept in mind that the particular expression and period of the predisposition or proclivity, weakness or defect, may change from generation to generation; what is oftenest continued on hereditarily seems to be a general defect, such as lack of control.

(4) One must not blink the fact that nervous and mental troubles are often wrapped up with sex,

especially with sex-impulses that are mistakenly hidden away as obscenities instead of being courageously faced and understood. Experts have nailed to the counter the false current dictum that continence is injurious to health. The fact is that exhaustion by self-indulgence among men is known to be a not infrequent cause of nervous breakdown in later years. In this connection we must not be over-ready to lay down the law to others, for both men and women appear to differ greatly in the strength of their sex-urge; but the general verdict of theory and experience alike is that the more controlled we are the happier and healthier we shall be. This sex-control is one of the greatest difficulties in human life; but there is hope in linking it to healthfulness.

(5) Just as pain is a danger-signal calling our attention clamantly to something going wrong in the body, so over-tiredness, sleeplessness, irritability, and "nerves" are danger-signals of troubles ahead. It is difficult to exaggerate the practical importance of these danger-signals of nervous mental troubles, for in most cases they are repeated several times for our warning, and in many cases it is possible to nip abnormality in the bud. An innate proclivity can sometimes be quieted down, just

as surely as it can be provoked; an acquired irregularity can sometimes be un-made or starved. From Dr. Easterbrook, a distinguished expert on neuromental disturbance, we quote a wise and useful statement: "It cannot be too strongly emphasised that no one becomes insane without previously being or becoming nervous. It does not follow that every nervous individual will become insane. Only a small proportion do so. Those who have an irritable nervous system should recognise it as such, their weak point of defence and resistance, and regulate their lives accordingly."

§ 7. Ductless Glands and the Mind

One of the great discoveries of the twentieth century to the credit of Professors Bayliss and Starling, who demonstrated what had been somewhat vaguely anticipated by far-sighted earlier physiologists, is *the regulative rôle of the ductless or endocrinal glands,* such as the thyroid and the suprarenal. They produce specific chemical messengers or "hormones" which are secreted into the blood and distributed throughout the body, like keys seeking particular locks, some to shut and others to open. The exciting, stimulating chemical messengers are

sometimes called "hormones," while those that quiet and soothe are called "chalones;" but oftener the same word hormones is applied to the brakes as well as to the accelerators. The glands or glandular tissues by which the hormones are made differ from ordinary glands, such as digestive glands, in having no ducts, or, to put the fact more strictly, in not liberating the hormones by ducts. The hormones are liberated into the blood, and thus distributed everywhere in the body; yet it is only on certain parts or qualities that the various hormones exert their potent influence. The hormones are invisible substances, of uncertain chemical structure, not of the nature of ferments. In two cases—the adrenalin of the supra-renal bodies and the thyroxin of the thyroid gland—the specific hormone has been artificially built up by the synthetic chemist.

Failure in the activity of the thyroid gland brings about slow speech and slow thought; it may spell arrested development; the child may become cretinoid and remain a sad, permanently infantile caricature of humanity, unless, indeed, it be relieved by that thyroid dieting which is one of the miracles of modern medicine. What is deficient in the body of the patient may be introduced from the thyroid glands of sheep or calf. As it takes three tons of

fresh thyroid of mammal to yield one ounce of the specific hormone (thyroxin), the value of the recently successful manufacture of artificial thyroxin is obvious. Here it may be noted that one of the characteristics of hormones is that a very small quantity goes a very long way. As regards the thyroid itself, which lies as a small paired reddish body on each side of our Adam's Apple or larynx, it only weighs about an ounce. When there is an exaggerated activity on the part of the thyroid, there may be an irritability of heart and feelings, and an unsightly protrusion of the eye-balls. But thyroid deficiency seems to be much commoner than its exaggeration.

The supra-renal bodies which lie in the vicinity of the kidneys weigh only about a seventh of an ounce, but the adrenalin they secrete is very potent. It affects the pressure of the blood, the beat of the heart, the breathing movements, the percentage of sugar in the blood, the tendency of the blood to clot quickly if there is a wound. This extraordinary hormone acts also as an excitant of the brain, and many of its effects are due to its stimulation of the sympathetic nervous system. In this connection there is an interesting psycho-physiological circle, for strong emotions, such as anger, operate through

the nervous system on the supra-renal bodies which increase their secretion, this again repercussing on the nervous system.

Smaller still, only about one-sixtieth of an ounce in weight, is the pituitary body, which grows down from the under surface of the brain and is lodged in a little depression in one of the bones in the floor of the skull. This organ produces a hormone that regulates growth, and an excess of it may result in the malicious unhealthy dwarf, while a deficiency may lead to the soft-headed giant. These two conditions of ill-regulated growth are to be distinguished respectively from the germinal variations which lead to the clever, well-proportioned, entirely healthy dwarf, and to the corresponding strong and mentally vigorous giant.

The reproductive organs of both sexes produce hormones which have a widespread influence throughout the body. In the male they activate secondary sex-characters, such as the antlers of the stag (restricted to males except in the reindeer), or the spurs and wattles of cocks, or the decorative plumage of many male birds. In female mammals they activate such functions as the production of milk, and in birds, for instance, they keep in a latent state the secondary masculine characters which

many females have as potentialities. In man these reproductive hormones begin to be formed before birth; in childhood there is a long period of normal latency; at adolescence they are formed again and bring about marked changes in the body; in later life they wane away, especially in women, in whom the removal of the inhibition may result in the appearance of a variable degree of masculinity.

The influence of the ductless glands on the mental aspect of our life is undeniable, and that is our reason for dwelling on the subject in this chapter. They affect our moods, disposition, and conduct; and their influence justifies what may be called a rehabilitation of the old doctrine of "humours" which result in "temperaments." The sanguine and the melancholic, the excitable and the lethargic may be interpreted to-day in terms of exaggerated or deficient production of certain hormones. This has been exaggerated by some physiologists and psychologists who speak of the glands "determining" or "dominating" the personality. Both these terms seem to us to be far too strong, except in pathological or semi-pathological cases. It is useful to recognise the powerful influence of the ductless glands, for they remove idiosyncrasies from the realm of the mysterious, and their variations can be

in some measure guarded against or counteracted. If there is a serious disturbance in the balance of the ductless glands, which normally work together in consonance, then there may be tragic shipwreck. Thus a youth of high promise may come to suffer shipwreck through thyroid deficiency; in other cases the list may right itself as the voyage continues. On the whole, the individual variations in the activity of the ductless glands are comparatively slight, and cannot be accurately spoken of as determining or dominating the personality. We must think of the other parts of the inheritance—the alert brain, the strong heart, the active liver, the big chest, the powerful muscles, and so forth. Some people talk as if the accelerators and brakes of the ductless glands were the only determining parts of the living engine.

§ 8. The Unconscious

It seems to have been well established that there is much in our everyday life which cannot be accounted for in terms of the thoughts, purposes, and feelings of which we may become aware in the focus of our consciousness. There are very influential deeper impulses which do not normally come to the

focus of consciousness at all, though we know a little about them through our recollections of our dreams, and through methods utilised by experts in psycho-analysis. Man's mental structure has been compared to a drifting iceberg, of which there is more below than above the surface, but this is a very cold and static metaphor! Some would prefer to compare man's mental activity to a polar bear's swimming in the sea for miles, with only the eyes and nose and the ridge of the head and back showing above the surface. That part of our mental activity which does not normally rise into consciousness is called "the unconscious," but it again has various grades. Thus it is usual to distinguish the *Primary* Unconscious—our deep hereditary predispositions sometimes badly called "instincts"—from the *Secondary* or *Freudian* Unconscious, which is formed in the individual life-time by automatic "repressions" of the unpleasant.

Let us think of our inner life from its highest grades downwards: (1) Highest there is our *rational* life in which we experiment with general ideas or concepts, or cherish high purposes, or are moved by complicated, controlled, and criticised emotions. So far as we know, man alone has the power of conceptual inference or reason. (2) Not

quite so high is our *intelligent* life in which we make perceptual inferences as some of the higher animals also do. Simple judgments of a concrete type do not require the conceptual inferences which mark reason in the strict sense. Mental images are as it were played with at this level, and these are coloured by relatively simple feelings of pleasure and the reverse. (3) But a great part of our everyday life is on a somewhat lower level, that of *habituated intelligence* or *intelligent habituation.* That is to say, whether it be reading the newspaper or riding a bicycle, or half a hundred other activities, we do much without requiring precise attention or control for each step. Often we give our major attention to a line of rational thought or speech while we are giving our minor attention to something that we have done hundreds or thousands of times before. In a habituation there is a chain of activities so organically automatised that it is easier for link B to follow A, and for C to follow B, and so on, than for anything else to happen. This is at once the value and the danger of "habit."

But deep below these three familiar levels there are inborn hereditary promptings—the appetites of hunger and thirst, the urge of sex, the reaction-tendencies of self-preservation, the primeval feel-

ings of kinship, and so forth, all of which a moralised man is accustomed to summon before the tribunal of his consciously controlled life. But besides these springs of conduct of which we are more or less aware, there are promptings which exert their power almost in secret. Thus there are the enregistered smiles and tears of childhood, which live and work though they may have been entirely forgotten. There are more ancient racial prejudices and attractions which probably go back to our pre-human ancestors. Thus the very widespread repulsion to snakes is probably older than Pithecanthropus the Erect or any other "tentative man." These deep hereditary forgotten promptings form part of the Primary Unconscious, and, as we shall afterwards see, one of the difficulties of a rational human life is that we are unconsciously swayed by "minds" or mental trends which are ancestral and sometimes anachronistic. Then we exert our ingenuity in discovering what we call "good reasons" for having acted or thought as we did. These primeval springs of conduct are sometimes of bitter water; but oftener, it seems to us, of sweet.

If we think of our inner life as a stream, we can picture as near the surface the succession of our everyday ideas, inferences, imaginings, memories,

and feelings, some at a higher level than others. Somewhat deeper there are our habituations for good and ill and not very far from the surface, though by no means always in the focus of our consciousness, are the main purposes or ideals which determine much of our conduct and the general trend of our life.

Very much further from the surface, though continually showing themselves in eddies and bubbles, are inborn general tendencies, such as kin-sympathy, loyalty to our immediate fellows, and the deep decencies of life. Here also is the sex-urge, asserting itself as maturity is reached, asserting itself most humanly when it has, as it were, to traverse a sunlit zone of emotions and ideals with which it is normally correlated. All these form the slowly moving deep current of our being, and deeper still are what we may venture to call the forgotten memories of our own childhood and others which belong to the childhood of our race. This, as we have said, is the Primary Unconscious.

Nearer the surface, but below the level of appetencies and desires, is the zone of the Freudian or Secondary Unconscious. This consists of complexes of more or less automatically "repressed" promptings and feelings, hidden away because dis-

harmonious with our ethical ideals and social conventions. In great excitement they may assert themselves riotously, but they are continually asserting themselves whiningly. They are kept down by a metaphorical censorship which does not operate by moral control, which would be victory, but by gagging them into non-expression. In sleep the censorship may be relaxed and the repressed images and desires steal out of prison—sometimes peopling our dreams. It is part of the task of the expert psycho-analyst to bring these repressions to the surface so that they be seen in the light of the sun, understood, faced, and, happily, got rid of.

The Freudian Unconscious is a very important factor in mental health, but we cannot do more than place it in its setting among other factors. Attention may be directed to the volume on the subject in the Home University Library. Our treatment here is quite elementary. Let us suppose that two deep springs of conduct are moved at once—the sex-urge, let us say, and the desire for the esteem of our fellows. They may conspire harmoniously, and the result is a pleasant chord. But they may conflict, not after the fashion of a sudden dilemma, like a lion in the path, which has to be faced there and then, but rather that one of them is baulked

by some habitual obstacle. Thus the sex-urge, imperiously demanding satisfaction, may be met by the habituations of Puritanical upbringing or by the economic impossibilities of marrying. The result is an internal conflict of incompatible driving forces. Let us consider the various possibilities.

(1) We may face the facts frankly, avoiding all subterfuge. Thus, in the case of the sex-dilemma, for instance, we may concentrate attention on the value of clean living; and it is always good psychology to dwell on the positive, not on the negative side. The issue may be an ethical struggle, in which we may be beaten, or in which we may succeed more or less in controlling the imperiousness of sex.

(2) Another possibility is that of a "double-life," on the Jekyll and Hyde lines, and this hypocrisy may be expressed in small details or on a big scale which demands considerable histrionic talent. It is easier to whiten the sepulchre than for a ravening wolf to appear as a respectable sheep.

(3) But the conflict may be evaded by a trick of our personality. We deny the sex-urge to ourselves; it is not to be spoken of or thought of; it is like a malignant disease to be hidden; it is censored or "repressed." This somewhat automatic *repres-*

sion is to be distinguished from a deliberate *suppression,* which may be part of the ethical struggle. The repression becomes a Freudian complex, a whirlpool in the deep dark waters of our mind, a "phobia" or dread. It may give rise to melancholy, brooding, hysteria. It is a tyrannous inhibitant of mental health.

A special case is the recrudescence of the pent-up energy of the repression in some strange form, often near or across the border-line of the pathological, as when repressed sex takes the form of some horrible cruelty. When the outcrop takes some less pronounced form, such as extreme religious intolerance, the tricked personality may exhibit great ingenuity in *rationalising* the new departure. Dr. Bernard Hart tells of the Sunday School teacher who reacted into extreme atheism because he had been disappointed in love. The reaction was due to pique; the intellectual reasons alleged were self-justifying inventions. If he had reacted from atheism to theism, or made any other volte-face, the intellectual reasons might have been stronger—that is not our business at present—but the point is that in any case the alleged reasons would not be the real reasons. In less serious changes of opinion and action we are all prone to

discover "good reasons" for our obedience to the promptings of the Secondary Unconscious. But it is not always recognised that the promptings for which we find rationalisations—invented "good reasons"—sometimes spring from the Primary Unconscious, and are often well deserving of obedience. For there is much more in the Unconscious than a medley of Freudian complexes.

(4) We started from the internal conflict of incompatible driving forces, and we must recognise as the highest victory that in which the prompting which cannot be gratified is relieved by *deliberate sublimation.* That is to say, a noble *modus vivendi* is found by linking the prompting to some correlated activity that is other-regarding and worthy. What Dr. Thomas Chalmers finely called "the expulsive power of a new affection" indicates an enviable solution. It was said of a famous mathematician that he got rid of his "sex" by his brain, and many noble women forget themselves in vicarious motherhood.

In difficult cases advantage should be taken of the advice of some *really wise* psycho-analyst—the trickster in this domain being peculiarly pernicious. By wise methods it is possible to unravel a complex, exposing it for what it really is, dispelling the

"dread" by daylight. But useful as this is, we cannot but feel that it fails of its full reward unless in some way there come about a unification of the life. This may be brought about by a new affection, a big new idea, a revived ambition, a strong enthusiasm. Loss of health always means some loss of unity, some distractedness, a pain that keeps one from attending, a phobia that keeps one from enjoying, a little blot in the brain that shuts out the sun. And restoration of health, to be complete, should include not only the removal of a local irritation, but a re-centring of the mental life. Hence the therapeutic value of a new 'ism or 'sophy, even if it does not seem to the outsider to be very sound! But hence, *a fortiori* the value of a noble ideal that has stood the test of time.

§ 9. Fatigue and Rest

(1) Compared with a cat or the like, a man has few resting "instincts"—or more accurately few resting habits and dispositions. This is in part the outcome of his active brain, and it is prefigured in monkeys. The highly sensitised nervous system is always being stimulated; the enregistered resources of the mind are always making suggestions towards

activity. Every one is familiar with the extraordinary restlessness of a young child when it is beginning to feel its way about the world. It is such a characteristically *motor* and *experimental* organism that there is worse than folly in trying to coerce it into keeping still. "Now don't be so restless," is often on the lips of the fond mother, often so tired herself that she cannot understand why her offspring cannot take a rest when it gets a chance.

(2) But man's restlessness is also due to his ambitions, often strong enough to make him quite careless of health.

(3) Working very hard sometimes begins as an anodyne and continues as a habit.

(4) Sometimes, curiously enough, the restlessness expresses a certain poverty of mind, for some people are afraid of themselves, disliking to sit quiet. They do not know "the bliss of solitude"; they are restless when left alone.

For these and other reasons man is a very restless organism, and the tax is tiredness. Hodge's study of the hardworked brain of the summer hive-bee shows that it goes rapidly out of gear. The nerve-cells become worn-out and the bee may work itself to death in a month. The structural results of nerve-fatigue are in some cases demonstrable,

as in the collapse of the nucleus of the cell; and it seems that there are fatigue effects which can be counteracted by rest while others cross the limit of repair. Besides wear and tear there may be an accumulation of poisons or toxins, and a common effect is increased acidity of the blood beyond the limit that can be counteracted by such organs as the supra-renals and the liver. Fatigue may be due (1) to over-work of the body, especially in conditions where evaporation from the skin is made difficult, (2) to over-eating and over-drinking, and (3) to mental worry, but the results are much the same in all cases.

After prolonged muscular activity there seems to be some exhaustion of the material utilised, and there is also some change in the nerve-endings on the muscle-fibres. The nerve itself does not appear to become fatigued, but a stronger stimulus is required to effect the passage of the impulse from nerve to muscle. It is of interest to notice that habituation makes this passage easier, and with a familiar set of movements over-fatigue does not set in so rapidly as in the case of the unfamiliar. There is less fatigue when the movements, though familiar, are not monotonous, and fatigue comes slowest when there is some rhythmic quality. Deli-

cate people could not dance so long as they do if it were not dancing; and the value of music in marching is familiar. Industrial experiments have shown the value of brief rests and of some music——a new light on the old ideal—"rings on her fingers, bells on her toes, she shall have music wherever she goes." Mental anxiety makes poisons just as a prolonged forced march does; fear affects the acidity of the blood and make the reaction from a surgical operation more difficult. Fatigue beyond a varying limit lessens the rapidity of responses, lessens the quality of skilled work, takes the edge off intellectual processes, lessens resistance to disease-germs, and tends to destroy initiative. The over-fatigued man seeks lines of least resistance, and this may become habitual; he tends to become irritable because of the poisoning; and he is apt to acquiesce in the ignoble. Little wonder that over-fatigue induces over-stimulation with alcohol, tea, coffee, and the like, which make more over-work temporarily possible and thus establish a vicious circle. Besides their psychological pleasure, both solitary and social, stimulants have their rôle in temporarily getting over "dead-points," but not even their most enthusiastic apologists, if in their proper place they require apology, can seriously defend the

over-stimulation that leaves one eventually more tired than before. Up to a variable limit smoking is of value for its psychologically quieting effect, and as a mild obliterator of the sense of fatigue. Beyond that limit, individually very variable, it first becomes a dangerous paralyser of the sense of fatigue, thus making more over-work possible, and beyond that lies nicotine poisoning.

The short and the long of it is that pronounced fatigue, like pain, is a danger-signal, which means "down tools." The remedy is to be found in stopping work, in seeking change, open air (for the sedentary), games, hobbies, and eventually sleep, "the sweet unconscious quiet of the mind." If the Sabbath requires any physiological justification, it certainly has it. Remember the Sabbath Day, or rest will forget you.

One cannot think of rest without recalling Luther's well-known saying: "When I rest, I rust," for this points to the obvious fact that rest need not mean either bodily or mental loafing. The best rest may be a change of activity. But Luther was well aware that man must be educated for his leisure-time as well as for his hours and days of strenuous effort.

§ 10. Exercising and Feeding the Mind

The analogy of the body suggests that the health of the mind demands exercise. We must have brain-stretching as well as physical gymnastics. We should always be reading *some* difficult book if we are to keep our mind in tone. It is a good rule always to have a problem to chew at. Every man should have his hobby, which he would rather ride than do nothing, and the further the hobby is from his daily walk and conversation the better for his mental health. When we think of the inexhaustible interests of the world, we naturally expect a hobby to become an *enthusiasm*—like music or gardening.

But the mind requires to be fed—even dieted. There should be no end to our education, no "finishing school"! We should, for instance, fill our picture-gallery with beautiful things, a relief in evil days and a joy for ever. Wordsworth spoke with appreciation of seeing pictures with the inner eye which is the bliss of solitude, and a wise man who had become blind once remarked that he was glad that he had "looked hard" at things when he had his sight. There is an ethical as well as an intellectual and æsthetic value in resolute practice in visualising—seeing things clearly with our eyes

shut. It makes for mental health to keep the heart with all diligence, for out of it are the issues of life. If we make a collection of mental pictures fair to see, it is easier to crowd out the ugly. The licentious man is not the man borne on the rocks by a tidal wave of passion, it is the man who cannot look on a woman without committing adultery with her in his heart, the man whose eye is full of guano, the man who is always chortling over filthy stories. But we need not labour the point—theoretically so plain, practically so difficult—that the healthfulness of the mind demands not only exercise but food. Sometimes also there should be mental fasting, there is so little time for reflection between our intellectual meals and almost pathological devotion to print.

§ 11. The Art of Forgetting

Many an animal learns to link together a sense-signal and a particular experience or kind of activity. The call, the scent, the sight have become associated with crouching motionless, with snapping the jaws, with a leap into the air, and so forth: and the linkage persists. This is simple associative memory, but it is near the beginning of an inclined plane on which we see the animal acquiring a com-

plicated dexterity, remembering how to open a puzzle box, which requires a sequence of operations in a definite order, of retaining the ability to get rapidly out of a maze without making a mistake.

In some simple cases of "homing" there is what is called "kinæsthetic" memory, that is to say, a registration and revival of muscular movements. In such cases, the bodily or physiological side is dominant. But when an elephant remembers an insult, and takes its revenge after six weeks, the mental or psychological side is dominant. When we revive a series of pictures, like Wordsworth with his dancing daffodils, we are exercising very pure mental memory; but even Wordsworth was well aware that his body shared in his recollections. Perhaps when the sleeping dog on the hearth-rug barks in its dreams, it has a memory-image of the rabbit who disappointed it in that field yesterday. On the other hand, there is not among animals any evidence of the association of *ideas*. But we must not forget that what we have to do with here is not remembering but forgetting.

What Forgetting Means.—For the sake of argument at least, let us assume that experiences which are vividly "kept in mind" have also a physical registration in the nerve-cells of the brain. We

can liken the registration to a dint, to an insertion in a card index, to a trodden path, to the marks impressed by a needle on the wax disc used in making a gramophone record, and so on. The one thing certain about all these metaphors is that they do not fit. We do not know what the protoplasmic aspect of memory is, and it must be remembered that in the opinion of many able investigators, like M. Bergson, the heights of memory are purely *mental* phenomena, no more due to the brain than a piece of music is due to the piano. It is the musician who plays; it is the mind that remembers.

But if we take the other view, that memory means a protoplasmic registration and inseparable from that a psychical activity, then what does forgetting mean in both these aspects? We forget an experience because it did not interest us enough, because it did not grip the mind, because we never thought of it again, because we did not link it on to the general framework of our thinking, because we had other things to attend to, and so on. These are some of the reasons for our forgetfulness, stated psychologically. What would they mean, stated physiologically?

The Tension of Memory.—A nerve-cell is a very intricate colloidal structure, and though no physiol-

ogist is aware how the correlate of a "memory-image" is registered in nerve-cells and persists there in a form that can be revived, the probability is that the impression means the establishment of specific sets of strain in the protoplasmic framework. The registering of the impression might be compared, metaphorically again, to magnetising a rod of iron, and we know that the iron may retain the magnetic condition for a long time or for a short time; or that it may lose it slowly or suddenly, and so on.

Similarly, the state of strain or tension induced in the intricate ultra-microscopic architecture of the nerve-cell may be lasting or transient. If it transcended what we may call the limit of organic elasticity, it may last a lifetime. If it was less forceful, it will tend to disappear, and the cell will sink back into a state of rest as far as that particular kind of tension is involved. But the idea we wish to suggest is that forgetting should always be easier than remembering, except when the original impression goes very deep, the reason being that the retention of the state of registration implies persistent tension, like a bent bow, like a compressed spring. The inertia of rest or oblivion is easier than the active state of retention or memory.

We do not believe, however, in the possibility of giving a physiological theory of true memory.

Worries.—Many people worry over their bad memories, and it is no doubt often troublesome—to forget names, incidents, useful information, faces, and promises. Starting on a long railway journey, we buy the book we bought a month ago; having rung the bell, we stand in a cold sweat because we have forgotten the householder's name. Yet how grateful we should be that we forget, or seem to forget so much. How embarrassed with luggage we should soon become if it were not for oblivion. How inhibited we should soon become if we remembered all our disappointments and failures. How depressed we should soon become if we had to remember all the ugly sights we have seen, all the cruel things we have heard.

Without denying that it is often for our good to remember some hard knocks, and bad mistakes, and great sorrows, we wish to plead for greater attention to the art of forgetting. There are ugly sights —horrible nightmares of human life that ought never to be visible—and they often linger in the memory like clots of festering microbes. There are unjust criticisms and unkind suggestions that we

forgive but cannot forget. Why not be rid of them for good?

But *how* are we to forget when we wish to forget? Part of the answer is given when we consider how we forget without trying. How easily we forget what we refused to admit beyond the "hall" of our mind, what we declined to be interested in, what we denied to be relevant to our real selves, what we never tried to revive, what we strangled by writing it down in our book of "Agenda"! Similarly, if the case be not serious enough to involve the more strenuous disciplines in repression and suppression, in connection with which the advice of an expert psycho-therapeutist should be followed, there is much which every one who wishes to forget can do for himself by using common sense and by seeking for all the healthful resilience he can come by. But the best half of the recipe is to crowd out the forgettable by an abundance of the gladly memorable!

§ 12. The Cult of Joy

Health makes for cheerfulness. There is a eupeptic happiness which the dyspeptic envy. When the ductless glands are working in tune there is

feeling of fitness. When there are few waste-products and fatigue-toxins lingering in the body, we walk with light feet. Sometimes, indeed, very perfect health expresses itself in an organic jauntiness, which is almost provoking to those who are irritable with fatigue.

But we are more interested at present in the converse propositions. A merry heart is the life of the flesh. Pleasant emotions make for better health—a fact which gives a touch of heroism to the cheerfulness of many invalids.

The researches of Pavlov, Cannon, Carson, Crile, and other physiologists seem to warrant three propositions: (1) Pleasant emotions favour the secretion of the digestive juices, the rhythmic movements of the food-canal, and the absorption of the aliment. (2) Delight of many wholesome kinds improves the circulation. Wordsworth was right in saying: "And then my heart with pleasure fills, and dances with the daffodils," or again, "My heart leaps up when I behold a rainbow in the sky." The joyousness of birds may be, in part, an expression of their very fine circulation, but it is not too fanciful to suggest that the circulation may be bettered by the joy. (3) It seems to be well established that good news affecting the sympathetic nervous sys-

tem and thus the supra-renal bodies may react beneficially through the whole organism; and it is likely that joy, such as æsthetic emotion, may operate in a similar fashion.

The practical hint is plain, that for the health of our bodies as well as for the health of our minds, we should make the most of the many joys of life —the birds and the flowers, the mountains and the sea, the meeting of friends, the delights of art. But these will not work towards health unless they are enjoyed for their own sake. The well-being or euphoria of body and mind cannot be attained by any faked joy. It comes only as the reward of appreciating the joys of life for their own sake. None the less the valetudinarian who begins with walks from a sense of duty may pass to a genuine love of the country.

§ 13. Minds of Our Own

One of the highest compliments we can pay a man is to say that he has a mind of his own, but it is very seldom true. Often indeed, we do not mean what we say, for in many cases we merely wish to suggest that our friend is a rather obstinate,

opinionative person, over-fond of being in a minority of one. For we all know the type of person who recalls the famous German definition of a professor: *"Ein Professor ist ein Mensch der anderer Meinung ist"* ("a professor is a person who is always of the opposite opinion"). But this may imply anything but "a mind of his own"; it often means an unusual slavery to an inherited mediæval mind. As some exaggerators would say, our friend is under the thumb of a persistent ancestral mind, an argumentative type of mind like that of one of the old scholastics, given to disputations, but without any strong desire to make an experimental appeal to facts.

We are all in the net which the past ever throws over the emerging future; and free thought is the rarest thing in the world. The so-called "rationalists" are often conspicuous examples of the very common, if not universal, mental habit that modern psychologists call "rationalising"—the process of finding "good" reasons to justify or exculpate our routine beliefs or disbeliefs. But, as Mr. J. H. Robinson says in his stimulating book, "The Mind in the Making": "Our 'good' reasons ordinarily have no value in promoting honest enlightenment,

because, no matter how solemnly they may be marshalled, they are at bottom the result of personal preference or prejudice."

The best examples of free thought are to be found among the philosophers who have had time, courage, and learning enough to run all their conclusions to earth, and to re-examine them with detachment and distrust, especially when they appear self-evident. Unfortunately, the result of this self-vivisection is often a paralysing scepticism or else a retreat into verbal nephology or cloud-lore. The second best examples of free thought are probably to be found among scientific investigators endowed with very analytical minds, who insist, not only on testing and verifying to the limit of their power, but on sceptically examining the implications of the descriptive formulæ they use. Often, however, the scientist deludes himself into the dogma that there are no fish in the sea except those that can be caught in his scientific net. To this we cannot agree, being convinced that there are other rights-of-way towards *truth* besides scientific method. In most cases, it is probably fair to say that philosophers and scientists are free thinkers (in the best sense) along certain lines, and enthralled thinkers on others. Even Sir Isaac New-

ton was hopelessly in bondage on the subject of Old Testament prophecy.

Sir Francis Galton, one of the three great initiators of the study of heredity, Mendel and Weismann being the two others, speaks of recent buildings in Italy where the expert can recognise a lintel taken from a forsaken palace, a coping-stone from a ruined cathedral, and a hearthstone from an old farm-house. So is it with man's composite inheritance, though, as a matter of fact, this is no legacy, but *himself*. No doubt, with our intricate ancestry, we inherit manifold strains and tendencies of a very precise nature, except as regards blending (or apparently blending) characters. This particulateness in inheritance is painfully clear in the case of abnormal peculiarities, but it is also well illustrated on the plus side in regard to desirable things, such as marked musical or mathematical ability. As far as the modern science of heredity informs us, there is no reason to disbelieve in the transmissibility of any well-defined characteristic, such as the Celtic temperament. If this is so, there may be no exaggeration in the thesis of James Harvey Robinson's "The Mind in the Making," that we are in large measure in the thraldom of our "ancestral minds."

"Stuccoed all over with Quadrupeds."—Most men at least are familiar with the disharmonies that arise through the mutinous claims of animal impulses of a low order, which recall Tennyson's words about the "ape and tiger" that form part of our inheritance, and Whitman's quaint description of himself as "stuccoed all over with quadrupeds." There is no more reason to be ashamed of a strong sex-urge than of a good appetite, but the point is that in the expression of the sex-urge and the hunger there are occasionally reassertions of anachronistic impulses which are better dead. It repels us to see a man "wolf" down his food, or beat his breast in the rage of a gorilla.

The same holds good in regard to savage impulses and savage ways of looking at things. Similarly, many of us carry about a tribal mind, and others have the smack of the Middle Ages. Yet there is a danger of exaggerating this solemnising truth into an error. For these so-called "minds" are merely strands in our mental fabric, strands which persist and yet are not uninfluenced by those with which they are interwoven. Our mind is not a menagerie of competing "selves"; it is the inner life of a more or less unified organism. At the beginning of every new life there is a fresh unifica-

tion of hereditary contributions—a new opportunity for damping down the discordant. We must think of primitive man as more than a new departure, carrying with him a burden of ancestral minds for better and for worse. He was a new synthesis, a weaving of many hereditary strands into a new pattern, not without its knots, but certainly not without its progressive artistry. The general trend of organic and human evolution is *integrative,* and it continues.

CHAPTER VI

WHAT CAN BE DONE?

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CHAPTER VI

WHAT CAN BE DONE?

All are agreed as to the value of health, on which we have laid emphasis in this book. Health is more than half-way to happiness; the health of the body makes for the health of the mind; health is a subtle touchstone of conduct; health tends to prevent acquiescence in the dehumanising and ignoble; and, fifthly, a high standard of health is economically of incalculable value to a nation. Every one must agree that health is something to be enthusiastic over; and since the nation's standard of health is, to say the least, low-pitched, the question presses: How can we educate towards health?

Many energetic and wise endeavors that make towards health are at present in active progress, but we deliberately place in the foreground the hygienic rôle of early education, always keeping in mind that the ideal is not merely the absence of disease—much as that means—but *positive* health.

This includes vigour, resisting power, capacity for initiative, clear-headedness, and *joie de vivre*.

§ 1. Enthusiasm for Health

It may seem to some to be beginning at the wrong end to say that the first thing to seek after is a quickened enthusiasm. Yet we say this very deliberately, for indirect methods in education are often of much more value than the direct. So we begin by suggesting more hero-worship and more heroine-worship in schools. By song and story, celebration and pageant, let us cultivate admiration for strong, enduring, robust types—some of them living now—who have done great things in human history. Those who have been weak in body have sometimes shaken the world, but it is on the average true that health helps towards the heroic. It is not difficult to indicate by good instances that the greatest value attaches not to the power of exhibiting a sudden outburst of energy, but rather to the patiently wrought-out fitness that can be depended on in a crisis. Darwin did not enjoy very good health, but no one knew better the power of persistence. "It's dogged that does it," he used to say. There is no doubt a special virtue in the sudden dash

and the *tour de force*, but even from the current newspapers, as well as from past history, it is easy to get examples of brave deeds that failed in the end, as in the rescue of a comrade from drowning, because the constitution fell below the level of the courage.

Perhaps teachers and parents are not quite generous enough in their appreciation of what may be called health-achievements in youth, nor quite long-sighted enough to praise the long walk as heartily as the record sprint. There may not be anything heroic in never having been absent from school in five years, but it indicates a quality of healthfulness that is of very high value to the community and the nation.

§ 2. Play

It may seem gratuitous to emphasise the value of play, especially in modern times, and yet the concept requires broadening out. It is apt to become over-conventionalised and over-standardised. If the biologists are right in their conclusion that play is more than a safety-valve for overflowing motor energy and high spirits, and more than social eurhythmics, being, in fact, *the young form of work*

and a relatively irresponsible period of apprenticeship to the business of life, then we must periodically revise the play-activities of youth. When we study the play of such animals as young otters, kittens, young foxes, lambs, we see that it affords a twofold opportunity: (*a*) It is a period during which instinctive promptings are tested and cultivated, and are often improved on by intelligence. (*b*) It is a period that affords elbow-room, without too serious criticisms or consequences, for new departures or variations—the possible raw materials in the evolution of behaviour. For social animals it is peculiarly important that they should learn to work together pleasantly with some measure of self-subordination. And this, in addition to the training and sifting of vigour and alertness, is one of the qualities which is cultivated by school games as they are to-day. Boys learn "to play the game," and what can be called *more* valuable? On the other hand, the risk is that in learning the lesson of self-subordination and team-work, there may be some forgetfulness of another high value of play, that of affording opportunity for originality. In short, play must not be lost sight of in games. The responsible position of "games-master" should include that of "play-master" or even "ploy-master."

In short, the cause of health demands that the ramble or exploration should count for as much as the match. No one would pit the one form of play against the other; all are useful and all are necessary; our point is simply that there is a real danger of the essence of play being lost in games.

§ 3. Artistic Suggestion

Another proposal that may seem trivial to many is to have in school a few pictures indicative of superb health at different ages. These might be supplied by some of the Medici Prints or the like, and it would be all to the good if they could be circulated and changed at intervals so that they did not become too familiar. It is not meant that the pictures should be tediously referred to; their influence should be left to seep in; no one nowadays doubts the value of quiet suggestion. Things being as they are, teachers are apt not to "adorn the doctrine of health"; thus some are over-studious and others are over-worked; therefore all the more need for having in every room an inspiring picture of Homo sapiens in good health. We speak of "pictures of health," and such, indeed, many children are; our proposal is merely to have some pictures of health

on the walls to help those at the desks, and to have them for different periods of life.

§ 4. Pattern of Healthfulness in Wild Animals

In urban conditions, especially, all but a few men and women—the elect or *élite*—are apt to acquiesce in a mediocre standard of health. It is not a case of a weak spot, but of an Achilles heel whose vulnerability spreads over the whole body. For various reasons, this sub-health may be pardonable after sixty-five years of age, but it is intolerable in youth, and one of the ways in which young people can be saved from acquiescence is by cultivating admiration for *the superb healthfulness of wild animals.* It is not merely that microbic diseases are all but unknown in Wild Nature, as we have seen; it is not merely that there is almost no environmental, nutritional, habitudinal or constitutional disease in Wild Nature; the point is that wild animals overflow with positive health. In urban conditions, where riotously vigorous wild animals are less familiar, it might be worth while keeping in school, for a short time at least, some playful wild creature like a squirrel, *lætior sole ipso.* In it the

children may find a model of healthfulness, requiring no apology.

§ 5. Education for Health

To give practical point to our suggestions as regards educating for health, it is necessary to make a digression. From the biologist's point of view, education is the control of "nurture" so as to make the most and best of the hereditary "nature." To a certain extent the individual has to recapitulate the history of the race, and it has always been, in theory at least, part of the task of parents and teachers to shorten that recapitulation as far as is practicable and profitable, the criterion being that the shortcuts must be such as help the developing child to utilise more and more of the social or external heritage registered in literature and art, customs and traditions, and in the framework of society itself.

There would be less disputing over the various proposals of rival educators, if it were more clearly recognised that there are three distinct but complementary aims: (i) There is in the first place the *training* of the young personality, as regards mind, character, senses, and body—a training which

should ideally include heart-expansion as well as brain-stretching, and manipulation as well as manners. (ii) In the second place, education includes *teaching* youth to use the everyday tools of life—to read, to write, to count—the Three R's in short. (iii) But third is the *informing* the mind with knowledge that enriches. Thus we might speak of the gymnastic, the utilitarian, and the informing aims of education. Mathematics is the best of all brain-stretching disciplines, but it can hardly be said to inform the mind; Natural History means a recreative informing of the mind, but in its simpler stages it is not, as a discipline, to be compared with Latin Prose. It is not asserted that the three aims of education are rigidly separable; thus reading and writing may pass into fine arts and become exercises in self-expression; arithmetic may become a brain-stretcher; the study of the world-without may form a useful part of training; and so on. Our point is simply that some confusion of thought is avoided if the three distinct aims are defined and recognised as complementary.

As the keenest enthusiast for health-instruction would not propose to interfere with training the personality or with learning to use the everyday tools of life, the question narrows itself to this,

What are the chief informing subjects which may be called *nutritive,* for they feed the mind? It appears to us that the three indispensable subjects are: (1) the history of our race; (2) the world in which we live; and (3) the laws of health and happiness; and what fills us with some dismay is the fact that these are the three subjects in regard to which those who leave school are in most cases most signally ill-informed.

How relatively unusual is it to find any appreciation of the great sweep of human history or even of the twenty changes that have had most influence on the social and international relations of mankind. How relatively unusual is it for young people leaving school to show an ability to find their way about in the world of Nature, whether animate or inanimate. Yet still more unusual is it to find almost any understanding of the laws of health and happiness. *Hinc illæ lachrymæ.*

So far, then, a reasoned preamble leading to our plea for *more school instruction towards health.* What forms should this take? Certainly there should be more teaching of sound physiology—a fascinating subject to most young people. There is perhaps a danger of teaching physiology prematurely, yet when can it be premature to breathe

into lime water and see the clouding as the carbonic acid gas is caught. At how many different levels can these simple experiments be repeated, becoming more full of meaning at each grade.

Once a year at least in every school there should be a repetition of one of the world's great experiments—that of growing seeds of the same weight and from the same plant in water-cultures which differ in the presence or absence, abundance or scarcity of various mineral constituents. How unforgetable is the series—with the starveling at the one end and the generous growth at the other. This is a lesson in "nurture," which should come long before instruction in diet or information in regard to vitamins. How striking, again, is the contrast between the plant growing in darkness and its counterpart growing in the light. We need not give other instances, for they have been worked out wisely by good teachers of school hygiene. What is needed is that their example should be followed, and that parents should insist on this life-saving instruction being given. For a long time it will be optimistic to ask for much; all we are suggesting is that by the time pupils leave school they should have a vivid, though quite elementary, picture of the ordinary functions of the body and of orches-

tration in health. We are thinking, of course, of the realistic type of knowledge that is based on things seen. How easy, for instance, it is to *see* the process of digestion going on in a test-tube or to *see* the circulation of the blood in the web of a frog's foot. Another invaluable lesson which has been very rarely learned in the past and is, indeed, only becoming possible now, is the lesson of the inexorableness of physiological consequences. For a long time it has been familiar in regard to things physical and chemical, but the coming generations will see the Reign of Law in the vital.

The second proposition is that there should begin very early—yet not too frighteningly early—some instruction in regard to the common and avoidable opportunities of becoming infected with some disease. How eloquent is the old-fashioned Pasteur experiment of boiling two flasks containing some organic solution, and closing one of them with cotton-wool when the steam begins to come out strongly. The other flask is left open, and the young pupil sees after a few days that the stuff in the open flask is rotting and smelly, whereas that in the closed flask is clear and pleasant. The inference to be drawn will vary, of course, with the age of the class, but after a few such experiments the

pupils will, at a suitable age, realise microbes. Every school teacher of hygiene knows, of course, how to do this, and does it well; our present point is that this sort of school lesson should be universal. Then the incidence of certain microbic diseases would be greatly lowered.

And just as we may make it vivid that the sunny side of the street is better to walk along than the dark side, because the light kills certain germs; so we should never fail to give the instruction its positive side, pointing out in this case that the light is a tonic to our life.

Many who will agree that education should include some sound physiology, dealing with the everyday life of the body, and who will agree that it should also include some very simple advice as to avoiding microbes and choosing the most wholesome food and surroundings, will part company with us at our next step, that education should include some definite sex-instruction in the senior classes. On this subject, which has hardly reached the experimental stage in modern times, there must be much difference of opinion, and the suggestions we have to offer are far removed from the dogmatic. What we feel quite sure about is that *some* steps towards sex-instruction should be taken, since

the prevalence of prurient ignorance and of discoloured, often stained, information cannot be regarded with equanimity.

(1) The sex-instruction should be differential, less for girls than for boys, less in some schools than in others, and it should be carefully graded according to years and according to conditions of public sentiment.

(2) The sex-instruction, until it comes to the final private talk with the headmaster, headmistress, or school physician, should not be given by itself. It should be linked judiciously, but never surreptitiously, to botany, zoology, biology, and physiology. Thus it may be *de-personalized*, and seen in a broader than human setting. Thus it is one of the large facts of biology—rarely stated though it be—that in the ascent of life from humbler to higher animals there is an addition of emotional and æsthetic factors to the physiological urge of sex, until, finally, in many a bird and beast physical fondness rises into love. Another factor is the co-operation of the sexes in the tasks of parentage, and this again may rise into joyous comradeship. Made into a text for moralising discourse, or woodenly told without illuminating imagination, this large fact of the evolution of love is of little avail,

but sown as a seed in the mind, and appreciated for its own sake, it may develop into a plant with fine flowers. It may be a mustard seed, which, when it is sown, is the smallest of seeds, but behold it groweth into a great tree in whose branches the birds of the air find lodging. We must have faith in mustard-seeds!

(3) We venture to lay it down as an axiom that sex-instruction in schools should always be positive and never pathological. The time for speaking of the pathology and diseases of sex is not in school. Rather should it be shown, yet without any preaching, that the love of man for woman, of woman for man, has been one of the great motive powers in history, impelling to noble deeds. The developing mind should have its sex-wagon hitched to a star. Perhaps if we thought more about cultivating flowers, the roots would be all the healthier. Indeed, it is not wise to be looking at roots very often.

It must be left, we think, to the discretion of the teacher how far he or she should go in sex-instruction, but we are personally convinced of the necessity of *doing something*, even if we do not go beyond "the loves of the plants," as Darwin's

grandfather called it. Consider the lilies, indeed; they certainly do not wear fig-leaves. "For him to whom sex is impure, there are no flowers in Nature." Sex-initiations are very ancient, and the experiment of dispensing with them does not seem to be working very well. It cannot be right that we should allow one of the greatest forces in life to steal upon the young organism like a thief in the night. It cannot be wholesome that information on a subject of profound influence on health and happiness should be acquired in a random and often clandestine way. It cannot be right that first-class textbooks on elementary physiology should entirely ignore the reproductive function. There would be great gain if the instruction given in school made this at least clear, that sex is not a subject to snigger at.

Opinions will differ not only as to the amount of sex-instruction that should be given, but as to those who should give it. We believe that it is merely an insincere evasion to say that it should be given by the parents. So far as we can discover, only a few parents dream of discharging such a duty; only a very small percentage of parents could do it decently well; in any case, it seems probable

that some one else would do it better, for the personal factor becomes too prominent when parents speak to their children on this subject.

We have suggested that a general knowledge of the significance of sex should emerge gradually from school-studies in botany, zoology, biology, physiology, and hygiene. We think that more specific instruction should be given by the teacher of hygiene, or by the school doctor (perhaps best of all), and that personal advice should be given by the headmaster or headmistress. For there should be available a brief manual issued by the Ministry of Health and compiled, after much mutual criticism, by a committee of the wisest biologists, physiologists, psychologists, and medical men, who would co-opt some representative teachers. We have seen many good booklets on sex for adolescents, but we are convinced that a wiser one could be written *co-operatively;* and in our judgment it would be best if it formed part of a general manual on the laws of health and happiness. For there is something deeply erroneous in keeping sex by itself.

But whether the sex-instruction is direct or indirect, through biology or hygiene, by teacher or school-physician, by word of mouth or by booklet,

care must be taken not to anticipate interest, not to excite, never to say what is untrue, not to teach what will have to be unlearned, not to make false mysteries such as dusting a flower's stigma with a pollen-laden feather might dispel, never to deal with the pathological, not to frighten, not to pretend that men and women are angels, and, above all, not to say too much.

§ 6. More Biology and Natural History

We wish to make a plea not only for more Natural Science in schools, but for more Natural History, even if it remain at a somewhat recreative level. Biological and Natural History studies are surpassingly interesting in themselves; they form a firm basis for education towards health; they have a mental and æsthetic discipline of their own; they are safeguards against the dangers of leisure-time. It may sound slightly high-falutin to speak of educating for leisure, but what do we mean save that education has failed of part of its ambition if the mind is not appetised with interests. Not to have a hobby is to invite temptation. Who can forget one of the shortest of New Testament parables: "And when the evil spirit was come forth from a

man, he wandered in desert places, seeking refreshment. And when he findeth none, he saith unto himself, 'I will return unto my house whence I came.' And when he cometh, he findeth it empty, swept and garnished. And he goeth out and bringeth seven other spirits more wicked than himself, and they enter in and dwell there. And the last state of that man was worse than the first." There is every need to be afraid of the empty house. "A bee in his bonnet," they said of the roving boy-naturalist, but, why, the bee in the bonnet was salvation.

There is another reason for pleading more strenuously for Biology than for any other science, that we are living in a mechanical age, and are in need of counter-actives. In spite of ourselves we become mechanistically pre-occupied, and how can we dispense with such concepts as growth and development, variation and heredity, which we cannot realise apart from life-lore of some kind. Those who are brought up in the country have a more complete nurture, being more closely in touch with life, no matter what townsfolk may think. There is a warning in Walt Whitman's line: "Buds to be unfolded on the old terms"—the buds of the child's inheritance. The warning is that the "old

terms" included seed-time and harvest, the pairing and the giving birth, the youth of animals and their play, the flower of the grass and its withering.

So we hope it is not harsh or ungenerous to say that we continue to be victims of and participants in mis-education. Our son asks us for bread (perhaps Physiology!), and with great trouble to ourselves and to him we coerce him into accepting a stone—of varied texture, but never nutritive. He asks us for a fish (Nature-Study, no doubt!), and we press upon him a serpent (e.g. premature Chemistry). He asks us for an egg (History, for instance), and with a heroic gesture we direct his attention to a scorpion (such as Grammar!).

§ 7. A Hopeful Note

From time to time in history there have been waves of enthusiasm for health, and one is overdue in our midst. Many endeavours are at present in active progress, and success will always reward what makes for integration. There is a familiar *vicious circle,* when growing youth sinks into sub-health and thus acquiesces in having less energy for endeavour, for exercise, for open air. His resistance is weakened and the sub-health becomes

more pronounced. Yet there are also *virtuous circles,* for nothing succeeds like success; and those who enjoy the thrill of vigour will make for more, and will be empowered to do so. It is a characteristic of healthfulness to wish to be healthier.

But it is necessary that the standard of health should be high-pitched. It includes the healthy mind as well as the healthy body, the cult of joy as well as of brawn. Healthy is but the precondition of being truly wealthy and gladly wise. In all these cases we must seek to avoid the simplicist fallacy. If we treat our horse like an engine, we shall get much out of it, yet not so much as if we treated it as a fellow-creature. If we treat a boy as a young mammal, it will be well, but it will not be best. We shall make more of him if we *also* treat him as a developing personality, a young citizen.

§ 8. Practicable Eugenics

Why do many people dislike so much even the word *eugenics,* which expresses one of the oldest ambitions in the world—that of having well-born children? A few because they recoil from a new-

fangled word for an ancient hope; a few because they inherit a Puritanical mental twist which leads them to regard begetting as something not to be spoken about; a few because they have invented, as an excuse for apathy, the hypocritical libel that eugenics smells of the breeding-pen, and is not applicable to man, made a little lower than the angels. All these are bad reasons for disliking to hear or think about eugenics. But the reason that influences most of us is that while we approve of the eugenic ideal, as every one must (for what is better than being well born?), we do not see what can be done towards its fuller realisation. Let us think, therefore, of *practicable* eugenics.

Impracticable Eugenics.—Sir Francis Galton, who invented the word "eugenics," defined it as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally." He also used the term not for the science, but for the art, of good breeding; and he was always careful to qualify his suggestions with the saving-clause that they must be consistent with the here and now conditions of social sentiment. Plato suggested methods of race-improvement which are not prac-

ticable in the twentieth century, such as infanticide. His proposals for the "purgation of the State" are too drastic for civilised men and women of to-day. Yet there are some who are courageous enough to say that they would rather be wrong with Plato than right with the world.

In reference to all the lopping-off suggestions it must be kept in mind that we do not know enough to act as reliable sifters of the race, that many weaklings, such as Isaac Newton, have become makers and shakers of the world, and that there can be no satisfaction in methods that merely remove results without getting at their causes. But behind these and other objections there is the fact that every infanticidal or Herodian proposal outrages the prevalent social sentiment of our time and of our race.

Similarly, as regards proposals for the sterilisation of undesirables, or, at the other extreme, for instituting a reproductive caste of fine types, on bee-hive lines, all that need be said is that *even if* the suggestions were biologically sound, they are inconsistent with what Galton called the present state of social sentiment. Let us first of all try what can be done along lines which are approved of by the ethical convictions of our time and race.

On Being Well Born

Other things equal, if a farmer is not keen on rearing good stock, he won't get it; and similarly if we do not return to the old enthusiasm for being well born, we are likely to deteriorate racially. In an age of mechanisms man tends to become mechanically-minded; he loses his sense of the fundamental value of good health and good stock; in any case he is not at present as biologically-minded as the ancient Hebrews or the old-fashioned Chinese. If men and women are so pre-occupied that they do not think about health except in a tiresome valetudinarian way, and do not think about heredity except snobbishly, then for lack of vision the people will perish. The chief reason why we cannot make more practicable proposals in regard to eugenics is that we are not caring intensely enough about being well born or well bred.

Practical Suggestions

(1) As the poet Heine said, half-laughingly, half-bitterly, a man cannot be too careful in choosing his parents. This becomes a practical suggestion when we change "parents" into "partners."

Do not marry for hygiene, but go where good health is.

(2) No sensible person can contemplate without grave regret the spoiling of more or less good stock by the introduction of defects like deaf-mutism, or predispositions towards pronounced mental instability, or to certain forms of, say, diabetes and epilepsy. Public opinion, as well as personal conscience, should be educated against—not the marriage, but the parenthood of those suffering from serious constitutional unsoundness.

The time does not seem to be ripe for much in the way of marriage-certificates and parentage-permits, and there is something suspicious in the fact that it is always some one else, not oneself, that one thinks of as not a fit and proper person to be a parent; but there is nothing unpractical in strengthening public opinion against spoiling good seed by bad, or in seeking to pre-occupy the mind and garrison the heart of youth with ideals of health in the widest and highest sense.

(3) Obviously undesirable types, who have fallen back on the community for support, should be segregated so that they cannot reproduce their kind. If the tares multiply without check, then in a few generations they will smother the wheat.

Fortunately there *are* checks—differential mortality and the like; but we need more rational social selection to take the place of the ever-lessening natural selection.

(4) Let every man be fully convinced in his own mind, if he can get it free enough from the inhibiting pieces of mind that he has inherited from his ancestry. No doubt there is something to be said on both sides, but we personally agree with many able-minded men who have come to the conclusion that children would often be better born and better bred if there were fewer of them. Birth control wisely regulated is, we think, part of practicable eugenics.

(5) The applications of the economic idea of "criticism of expenditure" are endless and far-reaching. All expenditure that promotes healthy rather than unhealthy occupations, that helps to multiply desirable rather than undesirable types (artists rather than "bookies"), that makes for well-paid work and gardens rather than for sweated labour and slums, is necessarily eugenic. The reverse is dysgenic.

(6) Every endeavour that makes for positive health or vigour and lessens wasteful indiscriminate thinning of the population, must in time improve

the quality of the race. Not only because good soil and sunshine increase the chances of good seed being produced and sprouting successfully, but because the healthier people are, the more will they be proud of having well-born children.

(7) We are all in some measure the victims of mis-education, which explains much of our apathy or hostility to eugenics. When the education of the youth of the country frees itself from anachronistic inhibitions and is readjusted to modern needs in the light of sound psychology and biology, then young people will be instructed in regard to the conditions of health, happiness, and effective work; and then eugenics will hum.

Progress is Many-sided

When we are pleading for more attention to eugenics, we must, of course, lay emphasis on what is bred in the bone, imbued in the blood, and inborn in the mind—on heredity in short. Individual fools may produce wise men, and individual wise men may produce fools; and so it is with physique; but ten thousand fine parents will have a much higher average grade of offspring than ten thousand of inferior stock. So the fundamental de-

sirability is that the fine parents should have more offspring (in moderation, of course), and the inferior ones fewer. But this is only a partial view, for hardly less important than hereditary nature is the environmental and functional nurture. Secure progress is never along one line only. Eutopias, eutechnics, eupsychics must join hands with eugenics.

To put it in another way, practicable eugenics must be taken to include all actions that operate selectively towards the relative increase of better stock. But we must be clear in our minds as to what we mean by "better," and what we are selecting towards. The modern study of heredity does not discourage high ambitions for the human race, and we must cherish these, remembering Aristotle's saying: "the nature of man is not what he is born as, but what he is born for."

§ 9. The Need for Sifting

If ten biologists were asked what features in modern civilisation gave them as biologists most anxiety, there would be great diversity in regard to those to be placed second and third. Some would say the very rapid increase of the

total population of the globe—which must be checked or lead to débacle; others would say the disproportionate number of women, for this always works deterioratively; others would say the growing indulgence in luxury and ease, and so on. But we are inclined to think that all would agree in placing *first* the relative slackness of selective processes working in the direction of progressive evolution. *There is too little sifting;* and advance in the past has always implied sifting.

In ancient times there was rigorous sifting of mankind. With a very insecure footing, man had to struggle against heavy odds. He had to contend with wild beasts; he had to discriminate between poisonous and palatable plants; he was recurrently faced by famine and pestilence; he had little mastery over the forces of nature; and one tribe sifted another, sometimes to the verge of annihilation. These were ages of stern sifting; they lasted long and they had great results. Man was sifted to good purpose.

As Sir Ray Lankester has pointed out with masterly clearness in his "Kingdom of Man," the ascent of man implied throwing off the yoke of natural selection. Nature said to her insurgent child, weaponless save in his wits, armourless save

in his gregariousness, "You must die." But man hurled back the answer: "Nay, I will live." And he has succeeded in living, and in living in a way of his own, a way in many features "unnatural." He has emancipated himself more and more from Nature's sifting, that is to say, Natural Selection. He has attained to extraordinary mastery over Nature; the dwarf has bent the Titan to his will. He has added the heights of the air and the depths of the sea to his navigable kingdom; he has made the ether carry his messages, and harnessed the lightning to his chariot; he builds up bread-making fertilisers out of the thin atmosphere; he has discovered the hidden energies of the dust. He plays with cultivated plants and domesticated animals; he conquers one microbe after another; he has begun to control generations yet unborn—in the plant and animal world at least. It comes to this, that man is transcending the System of Animate Nature to which he belongs, to begin with at least.

Professor Karl Pearson points out that some natural selection is still demonstrably at work among mankind, for there are some diseases that weed out the weaker and leave the stronger surviving. Yet this is a rapidly dwindling process, for the progress of hygiene and preventive medi-

cine tends to eliminate our eliminators; and if we devise methods for saving useful lives from gratuitous attacks, we have to use them for saving weakly lives as well. We could not, even if we would, reverse the development of social sympathy; and, in spite of modern friction and unrest, the sense of social solidarity is probably stronger in civilised countries to-day than it ever was before. But the danger of the new situation that has arisen is not merely due to the fact that the sense of fair play and of kin-sympathy is strong; the dilemma is deeper, depending on the fact that it is in the nature of a society to shield the individual from the full force of *individual* selection.

As Dr. Trotter shows in his "Instincts of the Herd," it is true from ant to man that the community or herd or society makes it possible for individuals to survive that could not stand alone in Nature. We need only recall the extreme case of those members of certain ant-communities which have lost the capacity not merely for procuring food, but for using it when it is there. They have to be fed by their minions. The analogy with some of the more parasitic members of a human society is obvious. Society has been a gracious shield, occasionally saving a genius; but it has also been a

dangerous shield, as the propagation of degenerates proves.

If Animate Nature has any lesson for man, it is that things worth having are gained and kept by struggle. It does not follow, of course, that the form of struggle must be of the type illustrated when one amœba engulfs another (one has heard of cannibalism at the other end of the scale), or when locust devours locust in spite of vegetarian principles, or when rat turns on rat; but some form of struggle there must be. Nature is ever against "the unlit lamp and the ungirt loin." "She winnows, winnows roughly, sifts." When a pair of blue tits work sixteen hours on a long summer day bringing two thousand caterpillars and grubs to their nestlings, that is a chapter in the tits' struggle for existence just as real as the carnivore's sharpening of its teeth and claws. We cannot assert, however, that the blue tits' industry does the butterflies or beetles any good.

The law of life in the past, said Herbert Spencer, has been that all animals are rewarded for the excellencies they have or show, and penalised for their defects. But whenever, on a large extent, it comes about that superiority is not duly rewarded, or that inferiority is not duly penalised,

that way danger lies. And if conditions should arise in which it is almost as well to be inferior as to be superior, that way perdition lies. Now, the throwing off of the yoke of Natural Selection without substituting for it any processes of sifting that can pretend to be adequately testing or consistent or well-thought-out means for man a difficult dilemma and a great danger. As a humane member of a civilised society, he *must* hold out the helping hand, and yet he knows that in being kind in the present, he is often being cruel in the future. And, as we have seen, it is not merely a question of kindliness, the risks of which might be obviated by increased charity organisation, it is that the growing solidarity or integration of society makes it easier for the inferior, or defective, or undesirable slacker to continue to live and multiply. He does not often secure much of a position, but he rubs along at the society's expense and he multiplies his kind.

It may be thought that we are under-estimating the difficulties of modern life, which surely suggest much stern winnowing. But mere difficulty in getting a livelihood or in becoming comfortable does not form a consistent and persistent sieve, operating towards a gradual diminution in the

number of lower grade types. The facts are not adequately known, but the decline of the birth-rate seems to be most marked among those types whose multiplication is most to be desired. There is undoubtedly, along with a higher birth-rate, a much greater infantile mortality among the feckless and the depressed, but every one knows that men and women are doing heroic work all through the land in counteracting this wastage among the babies. So the clouds gather, even if they are sunlit by altruism.

§ 10. Rational and Social Selection

It is something to see clearly what the danger is, for that must tend to prevent our acquiescence in coddling slackers and to break up our contentment with a régime in which selection is sporadic and often mistaken. But the problem is to think out a policy of rational and social selection to take the place of the natural selection which has so largely ceased. Some strands in the new sieves may be indicated: (1) The multiplication of the radically undesirable must be checked. In 1916 there were 600 mentally defective descendants of the five "Jukes" sisters, and only three of these

were confined in institutions. No race can stand this sort of thing for long. Man is not wise enough for much surgery, even if social sentiment would allow him, but the prevention of the multiplication of undesirables is another matter. (2) One may look for some re-education of public opinion in the lines of the old-fashioned eugenic ideals of pride of race and pride in having a vigorous family. It should not be possible to spoil good seed with bad, even when it is pecuniarily convenient. It should not be good form to advertise for a gardener "without encumbrances." It should not be legitimate to dismiss women-teachers just because they marry.

"Criticism of Consumption."—(3) There is in operation, as every one knows, a certain amount of selection which takes the form of insisting on efficiency requirements. The more of this the better, when the requirements are reasonable and when they tend to make life more difficult for unreliable types whose multiplication is not in the interests of the race. In many cases, however, the insistence on obedience, carefulness, honesty, and other good qualities does not do more than shift the delinquent to a job at a lower level of skill. (4) A powerful factor is to be found in "criticism of consumption," for it is possible for an enlightened and moralised

community to put an end—so gradually that the process is not cruel—to the less desirable occupations, the method being simply to criticise expenditure more conscientiously. If we chose, we could have more flower-growers, more musicians, more artists, and fewer (this can be filled in by any one of us). It is easy to condone the sins of expenditure we are inclined to, by damning those we have no mind to. (5) Perhaps the sifting may come sooner than we think, and in an undesirable form.

"The Moral Equivalents of War."—We do not refer to warfare, for in modern times that tends more and more to thin without sifting, or to work in the wrong direction by removing a larger number of the bravest and best. We refer to the yearly addition of fourteen to sixteen millions to the population of the globe. There are limits to this, and a very keen struggle for existence may set in, which would not necessarily sift in a progressive direction. It seems clear that man must more resolutely seek to discover what William James called "the moral equivalents of war," i.e. of the somewhat mythical, old-fashioned war in which the feeble, the stupid, the cowardly, and the like were eliminated in larger numbers. Perhaps it is safer

to say that man must more resolutely seek to discover rational and social modes of selection to take the place of Natural Selection, whose rule is almost over. What is needed is *a progressive evolution of sieves.*

§ 11. Other Practical Suggestions

We have given the foremost place to education, the second to eugenics (whose ends are partly to be reached by educative methods), and the third to methods of sifting or selection. We wish now to group together a number of practical suggestions which may commend themselves variously to different minds.

It is beyond our scope to speak of Sanitation and Public Health or of Preventive Medicine generally, which are being energetically furthered in our midst, and have already in some cases reaped a deserved reward.

Nor shall we say anything about the detailed ways of improving our personal health, for information on this subject is within the reach of all in numerous excellent handbooks, and there are many things in regard to which doctors do *not* differ. We would, however, use this opportunity of

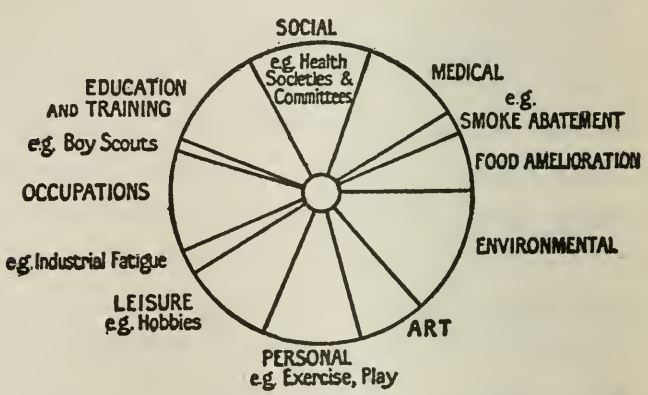
expressing our appreciation of the quiet efforts of clergymen, teachers, and family doctors who are often influential in instilling ambitions of healthfulness and of helping young people to clean living and high thinking.

Then there are numerous agencies which every right-minded citizen approves of, all of them making for health and most for more. We think of boy-scouts and girl-guides, of rambler societies, of open-air clubs, of gardening competitions, of climbing parties and walking tours. Every citizen should help the one that appeals to him most. Then there are many social organisations in favour of which the enthusiast for health should lean his weight, such as "Mothers and Babies Clubs," "Welfare Centres," "Women Citizen Associations," "Health Societies," and so forth.

We may sum up many of these endeavours in a scheme or diagram, which might be called the wheel of health (see next page).

We wish, however, to submit a few considerations of a more personal kind. There is a true tale of a great statesman who summoned a distinguished man of science and suddenly confronted him with the rottenness of the state of Denmark. What would science suggest should be done to secure

a physically A1 society? But the man of science, who knew too many counsels and too many objections to each, had not for the moment any constructive suggestion to offer. He went away cursing himself as a fool, though in a way he was too



A diagrammatic suggestion of the multitude of influences and endeavours, social, medical, environmental, personal, recreative, occupational, educational, and ethical that are making towards better health.

wise. But suppose one got such an opportunity, what would one answer to the question, What can be done to raise the health-rate of our nation?

In the first place we should say: Educate towards health. In the second place we should lay emphasis on the possibilities of eugenics. In the third place we should, as Darwinians, lay stress on the indispensableness of rational and social selec-

tion. Fourthly, in a long breath we should commend all the existing agencies that we know of that make for health, and we should say to the hypothetically patient statesman: Above all strengthen the hands of the Medical Officers of Health.

Then, having got the most important prescriptions off our chest, and becoming more at home with the Minister, we should venture on some minor counsels. We should recommend in all seriousness the discovery and utilisation of itinerant apostles, men and women from different avocations who are living health-advertisements, whose encouraging presence makes health appear the most desirable thing in the world. We would have them undertake missionary journeys throughout the country, going in twos like Paul and Silas. By their daily walk and conversation, as well as by their sound doctrine, these apostles would point the way to better health. Some biologists might accompany them as bad examples.

Again, we should start or revive in every town and village a Beautifying Society, with no destructive powers, but with every encouragement to make the bad better and the good better still. Its constitution would be Emerson's poem on Art. For many years in many places, we fear, the So-

ciety would be busy with house-hiding devices, for which it would be necessary to plant groves of fig-trees. There can be no doubt that beauty in square and street, in garden and home, makes for health; it is a subtle tonic and stimulus in the right direction; at the least it makes it more difficult to acquiesce in disease and sub-health.

Yet again, as seriously as before, we should press upon the Minister the desirability of instituting an order of merit for outstanding health. No doubt health brings its own reward, but social recognition should be added. There should be an aristocracy of health. Of course, there should be different grades and some differential treatment, for there are certain necessary occupations in which the risks of impaired health are still great, and it is easier to be healthy in some places than in others. But, to take an example, there might well be more frequent and conspicuous recognition of a workman, who for years is never off work on grounds of health, just as for the never-absent child. And the most distinguished holders of the D.O.M. for health would be men and women superbly healthy, not only in themselves, body and mind, but *in their children.*

We should be very fortunate with our Minister if we got this length without being shown the door.

§ 12. Wealthy, Healthy, and Wise

This is a familiar summing-up of our desires—to be wealthy, healthy, and wise. For while it is the way of some to decry wealth, only a few ever do this with sincerity, and even they only mean that they have devoted themselves with their whole heart to the quest of the true, the beautiful, and the good. Wealth implies a command of natural energies and an economical using of them towards the enrichment of life. Incidentally it means money or cowrie-shells; pathologically it means power over the bodies and souls of other people; normally it means securing increased well-being—more holidays and recreation, more leisure and change, more beautiful surroundings and less anxious thought for the morrow. We all look forward to a time when a large number of people will be able to attain to greater wealth, provided that they use it for well-being.

Wealth and Health.—Every one will allow that wealth without health is a mockery, but it is not always recognised that wealth may tend to promote

health if it succeeds in evading luxury. In two ways only is the poorer man favoured in the pursuit of health; he has more muscular exercise (often, however, too much), and he tends to eat simpler food. But the richer man has, on the whole, more fresh air, more sunshine, more space, more environing beauty, more opportunities for rejuvenescence, more ways of evading deterioration. So he ought to be very much healthier than his poorer neighbour. But we do not know that he is! It has been said that the curse of the poor is their poverty, but that is only a half-truth. For in many cases the curse of the poor is their inefficiency, which keeps them from becoming rich. Yes, there is a great deal to be said for WEALTH.

The Value of Health.—We must return to where we began—the pricelessness of health! Just as peace means much more than the absence of war, so health is much more than the absence of disease. Positive health means vigour and harmony, poise and balance. It means that the whole organism—body and mind—is working as a unity. An invalid has often a healthy mind and a cripple may shake the world, but on the whole there is a correlation of bodily and mental health: *mens sana in corpore sano.* Health is half-way to hap-

piness and it is often a sure criterion of morals. Loss of health is in many cases the consequence of doing wrong, though in other cases it may be the Nemesis of our neighbour's drains. Economically, too, health is of high value, and Britain would be more prosperous if the health-rate were higher. They say that three million industrial days are lost every year in Britain from rheumatism alone. If a fresh enthusiasm for health grips the country, it will bring more wealth and happiness, but the standard must be held high. The "healthy animal" is no mean ideal, yet it is for man a "biologism"—like a "materialism"—unless it be continued into a culture of the personality, which is wisdom.

Wealth without health is a mockery, and so is health without wisdom. It is not merely that a foul mind in a fair body is a sad contradiction; it is not merely that man is a member of human society of some sort, and must acquit himself as a citizen; there is a further truth that the ascent of man must include the culture of the personality—of the innermost self.

The Horror of the Hive.—There is a false simplicity in speaking of the instinct of the herd as dominant in human affairs, for man is much more

than a gregarious mammal. Similarly, the vivid picture suggested by the phrase "the human hive" is apt to be almost as fallacious as it is picturesque. Man knows what he is about; bees are largely slaves of instinct. Let us look steadily at the bee-hive to which uncritical enthusiasts so often invite out attention. The bee-hive is full of horrors.

No doubt there is wealth in the hive, the stores of honey in the honeycomb, one of the most beautiful forms of capital. No doubt there is also health in no small measure, prodigious industry by night as well as by day, and there is much to be said for the view that the susceptibility of hive-bees to certain microbic maladies or to Isle-of-Wight disease (in which a parasitic mite is involved) may be due to man's interference e.g. in over-feeding the bees with sugar. But while we cannot deny the strength and vigour of the busy worker-bees, the seamy side is their short life in summer. They work so hard that many of them die in six weeks. Careful neurological study of their little brains shows that the nerve-cells go steadily out of gear. The neurons cross the limit of recoverable fatigue, and then the workers die. With all their getting they do not get WISDOM.

Instinct-enslaved Workers.—The queen illus-

trates a specialised reproductive caste—a horrible idea. She is bound to an exaggerated maternity. The drones though not sluggish, are also non-productive. They, too, illustrate a specialised reproductive caste, and there is an extraordinary wastefulness, if one dare use such a word, for only one drone succeeds in fertilising the queen on her nuptial flight. He dies forthwith upon the "heights of love," and his fellows are massacred in the autumn —a bathos that no mere man can regard without repugnance. We begin to suspect that there is a very seamyside to the much-belauded social organisation of the bee-hive. And what does the whole social organisation depend on but a vast proletariat of sterile females—the instinct-enslaved workers? No doubt it is on the whole a smoothly-working organisation and in its way a wonderland, but when we think of the specialised reproductive castes of queens and drones, the exaggerated maternity of the former and the futility of most of the latter, the wastefulness of the massacre, the brain-fatigue and the short life of the usually sterile workers, we cannot but be impressed with the danger of achieving wealth and health, but missing that culture of the personality which we call wisdom. Heaven help us from going to the bees!

§ 13. The Biology of Progress

Professor Huxley was so much impressed by the ruthlessness of Wild Nature that he counselled Man to turn his face in the opposite direction, and to work *against* Nature's law: "Every one for himself and extinction take the hindmost." He compared Nature to a vast gladiatorial show, to a dismal cockpit. Every hedgerow shrieks with slaughter.

The defect of Huxley's picture is that it is only a half-truth. It is undoubtedly the case that living creatures are self-assertive and adventurous. From the very beginning it has been their central secret to accumulate energy, capitalising their gains, and they must find an outlet for what they have to spare. So they resent limitations imposed by physical nature or by their fellows, and hurl themselves against a tangle of difficulties which often sifts them. A few, of course, find lines of least resistance to their taste, and sink into ways of ease, but there are a thousand swimmers to every drifter, and thus we understand why there must be the struggle for existence which Professor Huxley painted in such vivid colours.

But it is very important for us to understand, as

Darwin himself made clear, that the struggle for existence includes *all* the creature's answers-back to the difficulties of circumstances, as well as experiments in parental care, mutual aid, and co-operation. To increase the flow of milk or the thickness of the lining of the nest may pay in the long run just as well as sharpening teeth and claws.

There is good reason to believe that the first successful creatures in the waters of the primal sea that covered the earth were single-celled without body—free-swimming organisms inclined to be of the plant persuasion, each sufficient unto itself. Each multiplied at its limit of growth by dividing into two, but apart from this there was only one law—the law of self-preservation.

Ages passed and a new era began. Bucklings of the crust of the sea-covered earth brought tracts of it within reach of the light, forming in certain places an illumined floor on which some of the free-swimming plants settled down. They grew into threads and tufts and fronds, they formed the plants we call sea-weeds. But this establishment of a *substratum* on which fixed plants grew made it necessary to arrange for fertilisation and diffusion, for bringing kin together, and for scattering the offspring abroad. Thus began a new era, when

the law of race continuance became as insistent as the law of self-preservation.

Among the simple sedentary plants which thus took root in shallow water it is probably that roving predaceous ogranisms appeared—the first animals, feeding on the green plants and on what they made, and by and by feeding on their own animal neighbours. They thus got ready-made munitions, and became more and more explosive in their actions. So the struggle for existence was intensified, and the struggle became keener still when the gradual raising of certain beaches led to the beginnings of dry land, with a terrestrial flora and fauna. We must not follow this line of thought further now; the important point is that, almost from the very beginning, the activities of living creatures included *caring for others*—offspring first, mates later, kindred later still—as well as *caring for self*. Unselfish activities are almost as old in Nature as self-preservation. No race can win continuance unless the individuals do their share in the way of self-subordination.

Thus the process of Nature's sifting—Natural Selection in the Struggle for Existence—begins to appear in a new light. It often means a penalising of the selfish and a rewarding of those that are

organically, instinctively, or intelligently unselfish. Goethe said that Nature was always taking advantage of her children's capacity for self-forgetfulness, but he might have added that she rewards with highest favour races to which the self-forgetful belong.

For to what creatures have the premier places been given but to birds and mammals, among vertebrates—good parents, faithful mates, kindly kin. And, among backboneless animals, do not the ants, bees, and wasps, biting, stinging, and belligerent though they be, likewise exhibit parental care at its climax? Does it not seem as if Nature's regime sounded a prophetic ethical note in the gifts, even of personal self-realisation, with which it rewards those creatures which subordinate the interests of self to the interests of the race?

There are, no doubt, terrible scenes in Wild Nature. A lion tears its victim to pieces while the flesh is still throbbing. Queen wasps devour their children, or it may be their sisters, before the winter sets in with its hardships and the queens are left sole survivors of the populous nest. In the egg-capsules of the roaring buckie and the dog-whelk the larvæ most advanced in development turn upon the others and devour them—a struggle to the death at

the very threshold of life, a cannibalism in the cradle at which many look aghast. But we are very apt to invest these episodes with a cruelty that is not really there.

The law of progress of life has been that each creature is tested and judged by its own qualities. Nature is stern in her condemnation of "the unlit lamp and the ungirt loin"; she is wholesome and healthy to a degree that Man may well envy.

But this contrast between Mankind and Wild Nature brings us face to face with the dilemma of civilisation, that in our tenderheartedness we often shield inferiority from the evils it brings in its train, and are so lenient in the present that we imperil the future. For we are too apt, in coddling the waster, to be cruel to the worthy. It is not to be thought, of course, that we can ever return to Nature's regime in its details—massacres of drones, infanticide of wasplings, cannibalism in the cradle, and all that sort of thing; humane sentiments forbid our even thinking of such a deliberate policy, though in our blindness or insincerity we sometimes approach in practice to something not less cruel.

What Man has to do resolutely is to substitute for the crude forms of Natural Selection more humane methods of selection, for without some sift-

ing we can neither maintain the ground that has been won nor continue to progress. The widespread idea that every man is as good as his neighbour is entirely against science and common sense. Progress without sifting is almost unthinkable, but Man's sifting must be humane, and the sieve must be woven in the light of the highest values, which the race at its best has always held to be best—the true, the beautiful, and the good.

We do not need to go "back to Nature," nor to "follow Nature," but we must learn from Nature a wise and humane strategy. Nature has much more to teach Man than he has yet learned, and it would be well, indeed, if Man could come closer to Wild Nature's standard of positive health and prolonged youthfulness. Man, however, has in the history of his own race safer guides than any science can supply, for with Man all things became new. Affiliated as he is to the rest of creation, Man stands apart—a social being, controlling his conduct in reference to general ideas and ideals. This makes a world of difference. What may be sound scientifically may be quite indefensible from the point of view of humanity. But it is this apartness of Man that has raised the particular difficulty which Spencer called the dilemma of civilisation.

Man has thrown off the yoke of Natural Selection, without having put in its place any adequate system of rational or social selection. We cannot get past Spencer's words: "The law that each creature shall take the benefits and the evils of its own nature has been the law under which life has evolved so far. Any arrangements which, in a considerable degree, prevent superiority from profiting by the rewards of superiority, or shield inferiority from the evils it entails—any arrangements which tend to make it as well to be inferior as to be superior, are arrangements diametrically opposed to the progress of organisation and the reaching of a higher life." We cannot cease trying to save individual lives; we cannot surgically get rid of our social liabilities; but we can all agree in this: to select whenever we can in favour of the healthy. Continually we have to choose between our fellows, as they amongst us. Other things equal, let health tip the balance. In organisation and in production there is continual selection for efficiency; what we plead for is persistent attention to the quality of positive health as one of the most reliable of criteria. The biological advice is: *Select for health.*

There have been eddies, blind alleys, retrogressions in Organic Evolution, but on the whole Life

has crept upwards. If birds do not show progress —in differentiation and integration, in mentality and mastery of life—as compared with worms, then we need some other word than "progress" to express the obvious advancement. If modern man does not show progress as compared with tentative men, or with primitive man, then we need some other word than progress to express the undoubted advancement. One of the reasons why some thinkers deny human progress altogether is that they do not know enough of the long past; another reason is that man is still so young; and a third reason is that in a complicated system like human society, progress is bound to be chequered. "Reversion is ever dragging Evolution in the mud." We advance in one direction and slip back in another.

To illustrate the obviously *particulate* character of progress in healthfulness let us take Sir George Newman's Report on the State of the Public Health in 1923. It is thought-provoking. It encourages us with its evidence of progress: thus the total death-rate (11.6 per thousand persons) was, for 1923 the lowest ever recorded in Great Britain; and the rate of infantile mortality—the death-rate under one year old out of each thousand born—was also the lowest ever registered—namely, 69.

This last fact means that the country saved not less than 45,000 babies' lives over and above the average saving obtained in the years between 1901 and 1910. "This is perhaps the greatest recent triumph of Preventive Medicine." At a recent meeting of the Sanitary Congress, the President called attention to the fact that in fifty years (since 1875) the death-rate had fallen from 23.3 to 12 per thousand. These three facts, though, of course, requiring analysis, are enough to show that there is something to be set against the Cassandra-ish wails we sometimes hear.

On the other hand, the very low death-rate of 1923 may have been partly due to the fact that the weather was not hard on young children or on old people. Again, there was an absence of widespread epidemics. There are other reasons for not being too jubilant over the minimum death-rate of 1923; but we need mention only the biggest—that about 40 per cent. of the deaths occurred under fifty years of age. It is quite plain that this is far from being satisfactory. More people should live longer. Writers and artists have sometimes depicted the trajectory of human life as like a steep-curved bridge—an ascent from infancy to childhood, from adolescence to mature strength, after which age-

ing begins, sinking quickly or slowly into senescence and death. At any step across the Mirza bridge there may be a fatality, but there are particularly dangerous ages, as every one knows, such as early infancy, adolescence, and the climacteric. There is something far wrong, however, when about 40 per cent. die before fifty. More men and women should be getting more out of life.

The Chief Medical Officer of the Ministry of Health may be relied upon not to say: "Peace, peace when there is no peace." He is militant against not only mortality—which cannot be more than lessened and shifted in its incidence—but against ill-health which can be indefinitely reduced, as Nature proves to us beyond all doubt. It is terrible to have to report so much sickness and physical impairment—terrible, not only because ill-health is, on the whole, an individual and a racial confession of failure, but because it means absence from work, broken time, and reduced productivity. Of enormous importance is Sir George Newman's sentence: "Probably such loss of time due to sickness, most of which is preventable, costs the country not less than ten times more than that which it loses owing to strikes and labour disputes." We see then that our progress is *chequered!*

Particular advance, e.g. in the conquest of a disease, we are familiar with, but what, must be asked, is progress as a whole? This is a big question, but must we not agree, when we think quietly, that progress is a balanced movement of society as a whole toward fuller embodiment of the supreme values (the good, the beautiful, and the true) in circumstances which increasingly realise the fundamental physical and biological pre-conditions of stability and persistence (namely, wealth and health), and in lives which are increasingly satisfactions in themselves, both individually and socially? This is indeed long-winded, but what we mean is that real progress concerns the big things—the good, the beautiful, and the true, as enrichments of society as a whole, and yet that these cannot be securely attained without a certain amount of wealth, meaning by that, of course, command of natural energies, nor without a much higher degree of positive health. To give one's strength to a particular progressive movement is always worth while, but concerted action is greater, and it depends on a unanimous coveting of the best gifts. Just as the biologist feels sure that stable progress towards the health of the organism must be associated with improved function and environment, so we must re-

cognise that the health of the body is inseparable from the health of the mind, inseparable also from an enthusiasm for the higher values here and now.

Yet it is the way of progressive evolution to work in virtuous circles. Enthusiasm for the good, the beautiful, and the true is sure to make for better health; and this better health will raise the pitch of the higher enthusiasms. Bad health an sub-health, on the other hand, must on the whole tend to shackle aspiration.

§ 14. Competitive or Co-operative?

The question has sometimes been put to us: there is keen competition in the Animal Kingdom and there is also intimate co-operation; which is most in the line of progressive evolution? Among some animals the rule of life is "Each for himself"; among others there is extraordinary self-subordination, sometimes an almost fanatical service of the community. Which way of living has been most rewarded and which holds out most promise to man? Should he take the individualistic badger or the socialistic bee for his totem?

The struggle for existence is an often misunderstood technical phrase for the manifold clash between living creatures and their environing difficul-

ties and limitations. It may be for food or for foothold, for self-expression or for luxuries. It may be between fellows of the same species, seedling against seedling, locust against locust; or it may be between foes entirely different in nature, such as carnivores and herbivores, birds of prey and mice; or it may be between the living creature and the changeful, callous, physical environment, such as the cold and the drought. Sometimes it is not the individual that struggles, but the community of which it forms a part, as is clearly seen in the raids of the ants.

Darwin was inclined to think that competition was most severe between individual and varieties of the same species, but he did not give many instances. Apart from reference to the overcrowded seed-plot and the like, he spoke chiefly of the competition between different *species* of rats, cockroaches, bees, charlock, swallows, and thrushes; and even in regard to these he spoke not very convincedly nor convincingly.

Of great importance is it to appreciate Darwin's broad view of the "Struggle for Existence," as in the sentence: "I use this term in a large and metaphorical sense, including dependence of one being on another, and including (which is more impor-

tant) not only the life of the individual, but success in leaving progeny." This sentence is not itself very luminous, but it is evident from the context that Darwin used the "Struggle for Existence" as a formula including all the reactions and endeavours that living creatures make against environing difficulties and limitations. And now we see the competitive and the co-operative modes of life in their proper biological setting. For they are the two chief ways of reacting in the struggle. One way out is to intensify individual effort, to tighten the belt, to set the teeth, to hustle and jostle, to strain and strive. This is the way of the eagle and the lion. The other kind of reaction is to join hands, to link lives, to practice mutual aid, to subordinate self, to increase parental care and kin-sympathy. It is the way of the rook and the beaver. Thus we see that the two modes of life that we wish to contrast—competitive and co-operative —are not antithetic alternatives. Both are successful, both have their rewards, and both have their dangers.

It must not be thought that the contrast between the solitary and the social, the competitive and the co-operative, is the same as that between egoistic and altruistic types, between the selfish and the

other-regarding. This is a common fallacy. The individualistic otter is just as careful a mother as the co-operative beaver. The golden eagles in their lonely retreat are as devoted parents as the gregarious rooks. The solitary bees provide for their progeny as effectively as do those that live in colonies and hives. The contrast between the competitive and the co-operative is primarily social, not ethical.

What is the contrast? The co-operative regime, which we may also call social, communal, gregarious, and so forth, always implies some measure of self-subordination on the part of the co-operators and some alleviation of the individual's struggle for existence, for society is always a shield. The danger is a loss of individual all-roundness and independence, and a sheltering of weak types that would be eliminated in individualistic conditions. Moreover, as in ant-hill and bee-hive, the subordination of the individual may become almost pathological. The self-sufficient, actively individualistic, "each for himself" way of living has the advantage of fostering sturdy vigour and all-roundness of development. But it has the disadvantages that it presents fewer opportunities for the cultivation of kin-sympathy, that it limits the mastery

of the environment, and that it may involve an intensification of the struggle for existence to the unendurable uttermost—which spells extinction.

The open secret that Man may read in Animate Nature is that there is much to be said for both the competitive and the co-operative ways of living. Man, though one species, must try both. Towards given ends, at particular times, in certain circumstances, man should learn from the eagle; towards other ends, at other times, and in other circumstances, he should learn from the rook. Both ways are best, whereas no good word can be said for parasitism.

But when the one regime should be followed and when the other is a difficult question, and from Natural History we get but a few hints. Certain modes of life, such as fishing and hunting, favour the "each for himself" policy; certain inhospitable and difficult environments operate against the possibility of a communal regime; certain constitutional and temperamental peculiarities give the animal a bias against or in favour of co-operative self-subordination. Perhaps there is some deep psychical difference between a crow and a rook, the one solitary, the other social, both highly intelligent.

A common fallacy to be guarded against is cred-

iting the particular way of living with engendering all the virtues of those that follow it. The solitary or individualistic mode of life is illustrated in Britain by wild cat, fox, otter, badger, pine-marten, stoat, weasel, hedgehog, mole, shrews, hares, squirrel, and dormouse—a very attractive set of animals, much more attractive than the gregarious types, rabbits, rats, mice, voles, and bats, with the single exception of the deer. But we have to correct this in other countries, remembering the cleverness and loquacity of monkeys, the wisdom of the elephants, the intelligence and adventurousness of wild horses, the defence of the young among gregarious ruminants, the kin-sympathy of the prairie-dogs, and so on. We must not pick and choose when we seek corroboration from the animal world.

Similarly when we admire the effectiveness, the intelligence, the kin-sympathy of elephants, wild horses, beavers, wolves, parrots, cranes, and so on, we must not give all the credit to the mode of life. For in the first place, there is probably some prerequisite to close co-operation, some fineness of material necessary to start with, as in monkey and elephant, horse and beaver, crane, and parrot; and in the second place there is often a considerable degree of commonplace gregariousness without any

marked enhancement of the animal's qualities, as may be illustrated by rabbits, rats, and sparrows. Often, indeed, the co-operative animal has a suggestion of inferiority, simply because the sociality is a shield to types which are not individually very strong, such as mice and slave-keeping ants.

When we consider the co-operative or societary mode of life in its many grades, we cannot but admire the way in which it secures stability in the struggle for existence, the increased economy and efficiency, the possibility of permanent products and tradition, the kin-sympathy and socialised self-subordination, the shield thrown over individual variations and tentatives. It is plain that human progress must largely lie along the co-operative line of evolution.

Yet on the "each for himself" mode of life there evolve notable good qualities—sturdy independence, resolute all-roundness, originality, and a certain fullness of life—until the struggle becomes too intense. Thus it becomes one of the deepest problems of the statesman to guide the communal co-operative evolution so that it does not involve jettisoning the rewards of competitive individualism. That neither man nor bee has solved this problem is painfully evident.

CHAPTER VII

VIS MEDICATRIX NATURÆ: A SUMMARY

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1. In many different ways one may speak of the healing power of Nature—*Vis medicatrix Naturæ,* and all of them are instructive. One may speak, for instance, of the healing virtue in many natural substances, both animal and vegetable, some of which are extraordinarily quaint. Thus more than one snake carries in its gall-bladder a sure antidote to its own poison. We have seen that the old advice that the coward should eat of the heart of a lion, so that he might be brave, is echoed in the modern treatment of a cretinoid child with the thyroid gland of a sheep? *Vis medicatrix Naturæ.*

2. Interesting also is the power of repair exhibited by many living creatures. One of the Big Trees or Sequoias, which was a seedling in 271 B.C., suffered a burn 3 feet wide when it was 516 years old, and spent 105 years in folding its living tissues over the wound. When it was killed at the

age of 2171, a Methuselah among trees, it was engaged in healing another great wound 18 feet wide and about 30 feet high. *Vis medicatrix Naturæ.*

3. A sponge can be cut up and planted out like a piece of potato-tuber. It may be minced and pressed through a cloth sieve without its power of regrowth being lost. In propitious conditions, such as summer weather, an earthworm is not slow in regrowing a new tail or even a new head. Similarly a snail can regrow its horn and the eye at the tip, even unto forty times. And this regenerative capacity is no mere curiosity, for, as Lessona and Weismann have shown, it tends to occur in those animals and in those parts of animals which are in the natural conditions of their life peculiarly liable to non-fatal injury. *Vis medicatrix Naturæ.*

4. Many other instances might be given of the biological aspects of Nature's healing power. Thus we have referred to the activity of the body-guard of migratory phagocytes which deal with intruding microbes, or the power the blood has of producing intrinsic counteractives or "anti-bodies" which deal with poisons or toxins.

5. It is interesting also to think of the way in which Nature contributes to the hygiene and healing of our minds, so apt to be disturbed by the rush

and racket of civilisation. There are deeply-rooted, old-established, far-reaching vital relations between man and Nature which cannot be ignored without loss. Man was cradled and brought up in touch with Nature, and he must ever return to her, like the wandering birds whose life is never full until, moved by an organic homesickness, they come back to nest in the place where they were born. Man needs to sojourn with Nature in order to get certain fundamental impressions without which he is impoverished. Moreover, the study of Nature is a brain-stretching exercise—eminently healthful, and while it rewards the discoverer—even the learner—with light and power and joy, it subjects him to a discipline which engenders humility. For is not all our science rounded with mystery—mystery as to essences, mystery as to origins, mystery as to mutations. What we are surest of is the fundamental mysteriousness of Nature.

6. But the phrase *Vis medicatrix Naturæ* is also a convenient title for the impressive fact that *Nature is all for health.* This is one of the outstanding facts which a study of Animate Nature reveals. As we have seen, there is almost no disease in Wild Nature, though there is much among domesticated animals, or in cultivated plants, or in cases where

man has replaced natural conditions by artificiality.

Disease is disturbed metabolism, implying the occurrence of vital processes out of place, out of time, and out of tune. It is true that the boundary-line between the normal and the pathological is often very vague; what is normal in one animal, such as the dying away of bone at the base of the stag's antlers, or the glutinous secretion from the stickleback's kidneys (used in binding together the materials of the nest), or the pigeon's milk from the crop of pigeons (used in feeding the young), would be pathological in another; what is normal at one time of life may be abnormal at another; but disease is, on the whole, characteristically *disintegrative and involutionary.*

From a general biological point of view, three kinds of disease may be distinguished—constitutional, modificational, and microbic.

(1) Constitutional diseases are due to some radical germinal disturbance or defect, and may be illustrated by certain forms of diabetes and epilepsy. These constitutional diseases are unknown in Wild Nature, because they are contradictions in terms. If they appear, and of this there is little evidence, they are immediately wiped out. They are nipped

in the bud. The sieves of the Struggle for Existence do not admit of constitutional disease.

(2) Modificational diseases are due to some deteriorative peculiarity in surroundings, food, or function, and may be illustrated by lead-poisoning, beri-beri, and rickets. These modificational diseases are almost unknown in Wild Nature, for organisms will rarely tolerate conditions of life that are positively deteriorative. They cannot be coerced, either by fear or ambition, into submission to abnormal conditions of life. In the struggle for existence they are sometimes forced into conditions of parasitism and saprophytism in which degeneration tends to occur; but this degeneration is in most cases a racially-established adaptation and not an individual modificational disease.

(3) Microbic diseases are due to the intrusions of virulent Bacteria and Protozoa to which the organism's reactions involve serious disorder, such as inflammation and anæmia. These microbic diseases are common among domesticated animals, but very rare among the wild. For it must be clearly understood that while there are endless microbes in wild animals these have normally established a live-and-let-live compromise with their hosts, and do not usually cause disease. But disease occurs when

the microbes are transferred to a new host without any natural defences, or when the original host is in some way enfeebled, for this gives the microbes an opportunity to get the upper hand.

Much the same may be said in regard to parasites. In most cases a give-and-take *modus vivendi* has been established between parasite and host, and serious disturbance does not occur unless the parasite becomes transferred to a new host, or unless some weakness of the host, as in so-called grouse disease, gives the parasite an opportunity for unusually prolific multiplication. It is obviously not in the interest of the true parasite to kill its host; for that would be killing the goose that lays the golden eggs. Three saving-clauses should be noted: (*a*) that we are not speaking of domesticated or semi-domesticated animals, nor of cultivated and artificially-disposed plants, for these have *their serious, often fatal, parasites;* (*b*) that the definition of even endo-parasitism is somewhat vague, for there is a great difference between a parasite feeding on the semi-digested food in the alimentary canal of its host and a parasite living on the feeding tissues of its host, such as the muscles or the blood; and (*c*) that such forms as larval Ichneumon-flies, which devour the living caterpil-

lar in which they have been hatched, are not so much parasites as predatory animals which devour their host from within, not from without.

7. If there is almost no disease in Wild Nature, why should Man show so much? The answer is manifold. (*a*) The exploring restlessness characteristic of certain human types—on the whole the stronger in physique and morale—implies exposure to new microbes. (*b*) Necessity and ambition bring about submission to modifying influences of a deleterious kind, as in unwholesome occupations. (*c*) Love of pleasure leads to many kinds of stimulation, which, while sometimes aiding in rejuvenescence, are apt to make for premature senescence. (*d*) More important, perhaps, is the fact that old-fashioned modes of functioning, e.g. in eating and breathing, persist in new conditions to which the body requires fresh adjustment. Thus our thirty feet or so of food-canal, well-adapted for pre-historic days of irregular meals with much useless material in the menu, is rather embarrassing to-day. (*e*) But still more important is the absence of rigorous selection for health, since this allows of the prolonged survival of under-average individuals, and permits of the hereditary entailment of their deteriorative constitutional peculiarities.

8. On the other hand, these reasons for Man's lack of health need not be regarded as permanent. The advance of medicine has shown that microbic diseases (e.g. smallpox and diphtheria) can be conquered; and that the conditions bringing about modificational diseases (e.g. rickets and beri-beri) are remediable. A radical constitutional disease or defect cannot be got rid of, but improved "nurture" may mitigate its individual expression. And while there is sometimes nothing for the individual save to dree his weird, the spread of science and the education of public opinion will lessen the likelihood of the taint being handed on to subsequent generations.

9. A second big fact regarding the healthfulness of Wild Nature is the absence of senility and the rarity of more than mild senescence. Some organisms live for days, others for weeks, others for months, others for years, others for centuries; but most of them die or are killed while physiologically young. The Big Tree or Sequoia cut down at an age of over 2000 years was not senile. At least some of the Protozoa seem to enjoy exemption from natural death, and perhaps the same is true of some simple polyps and of some simple Planarian worms. For most types, however, there seems to

be a normal length of life's tether, which is immediately determined by the physiological constitution and the possibilities of counteracting senescent by rejuvenescent processes, but which has also been adjusted adaptively by ages of selection. Thus a stock that continued to reproduce after its reproductive prime was past would automatically tend to be eliminated. For many animals and plants the end is violent death: some are devoured, others are pushed off the scene by an environmental crisis, such as the approach of winter, which they can neither meet nor evade. Domesticated animals, such as dogs and horses, often show the senility characteristic of an unduly sheltered life; and some semi-domesticated animals, like hive-bees, show in their nervous systems the irrecoverable accumulations of fatigue-effects; but there is very little hint of this in Wild Nature.

Senescence may be marked by the accumulation of poisonous waste-products; by a wearing out of hard-worked organs, especially those which show no cellular replacement (notably the Vertebrate nervous system); by an exhaustion of internal secretions and so on; but the deep reason for senescence is the wear and tear of the more stable cellular framework in the interstices of which the

turmoil of metabolism goes on. It is not the living matter itself that grows old, but rather the laboratory furniture, which is not readily kept in a state of perfect repair. In many animals, as Professor Child has well shown in his "Senescence and Rejuvenescence" (1916), there are remarkable rejuvenescent processes which stave off senescence. In some types, not always very simple, the furniture of the colloidal laboratory can be taken to pieces and reconstructed, thus securing a new lease of life.

10. Why should Man have a monopoly of senility? The answer is again manifold. (*a*) If Natural Death be due to the mounting up of physiological bad debts in the framework of the cells, these debts are likely to be more serious and more unpleasantly pathological in the case of Man because his life is often so artificial. (*b*) Compared with most animals, Man has a very poorly developed resting instinct, and he is given to use a variety of stimulants, many of them admittedly pleasant, which enable him to work when he should rest, or narcotics, like tobacco, which dull the sense of fatigue. A large number of even educated men are unaware of the biological significance of sleeplessness, dull discomfort, or pain; they do not realise

that these are the organism's danger-signals indicating the need for rest and change—change of scene, change of interests, change of diet, and so forth. (*c*) Because of the slackness of selection for health in mankind many human beings are born old (a state that can be readily induced by artificial means in Planarian worms) or are by hereditary handicaps predisposed to premature senility. A deepening of social sympathy and a strengthening of the feeling of social solidarity have led to an evasion of the ordinary processes of Natural Selection, to the cruder forms of which no wise man would seek to return, and this sheltering has meant the survival and senility of many defectives who, in earlier days, would have been eliminated in their youth before multiplying their kind. As the world has in exceptional cases owed much to men with some serious defect or weakness, we should be careful to recognise that what is mainly undesirable is not the survival of these handicapped types but their propagation. (*d*) Most important of all, however, is the fact that the more highly differentiated the organism, the more difficult it is to secure the rejuvenescence changes which at lower levels are able to counteract senescence. It goes without saying that many of the rejuvenescent processes

seen in some of the lower animals and in plants are quite impossible in the case of Man. It is for science to devise for Man new and subtler methods.

11. As length of life is determined by the initial constitution and by the adaptive racial punctuation, there is probably little that the individual can do in the way of lengthening his life-tether. Yet much can be done in raising the duration of life in large sections of the people in which it has fallen below the racial average, and still more can be done in lengthening out the period of relative youth. We have to bear in mind the general biological idea of temporal variations, that different parts of the life-curve may be lengthened out or shortened down, and that this variability may facilitate adaptations to different conditions of life. One species may differ from another by a prolongation of one chapter in the life-history and by a telescoping of another; and we know that this might come about in Vertebrate animals by variations in the activity of the glands of internal secretion. There are indications in civilised countries that a variation is in progress in the direction of prolonging the period of youth and shortening that of senility. Mere length of life is not in itself a great gift; what matters is the pitch and effectiveness of life and the

self-satisfying grip of the higher values. It is open to almost all of us to determine what we are *not* to die of, and it is open to many to secure what kind of old age will be theirs. Much may be done to make sure that we shall be in certain respects young, as is the way with most animals, when we die. Some of the finest types of humanity are octogenarians who remain in many ways like boys, as Montaigne said of his father.

12. A third big fact in regard to Nature's healthfulness is that throughout Wild Nature there is sounded the note of exuberant and insurgent health. Just as peace is much more than no war, so health implies much more than no disease. Health implies a reaching forward to a life of greater fitness, fullness, and freedom. Health means: (*a*) a harmonious correlation of the parts of the body and of the inner life with the outer; (*b*) a quality of vigour, difficult to define, which implies reserves of energy, plasticity, and a power of initiative; (*c*) a fitness of adjustment to the conditions of life in so far as these make for conservation and enrichment; and (*d*) a certain joyousness, which acts as a tonic to health, and is dominant in such creatures as birds and very conspicuous in the period of youth. The old sayings: "He that is of a merry

heart hath a continual feast," and "A merry heart is the life of the flesh," are corroborated by the researches of Pavlov and physiologists of his school. For is it not certain that pleasant emotions favour, for instance, the secretion of the digestive juices, the rhythmic movements of the food-canal, and the absorption of the aliment. Just as the heavy cloud of "tropical depression" is largely gratuitous and remedial, being due to hookworm, so "civilisation depression" is in part due to neglect of the well-springs of natural joy—such as a delight in Nature.

13. Our general thesis is that if we disregard the bypaths—such as the drifting life of parasites, the slow-going ways of animals in caves (which are asylums for the weakly), and the too easy régime of saprophytes—we find throughout Nature not only an absence of disease, but an exuberant healthfulness. Nature is all for health: *Vis medicatrix Naturæ.*

It must not be thought that we are repeating the old cry "Back to Nature." If that means simpler living and less artificial excitement, more sunshine, open air, and joy, it is, of course, sound advice; but the fallacy of the cry is its failure to recognise

that what is needed is in part fresh adjustment to novel conditions from which there can be no going back. Even if increase of population and diminishing returns from the exploitation of natural resources lead in centuries to come to a migration from urban to rural conditions, it will not be the rural life we have known in the past. Our practical suggestion is not "Back to Nature," except in the wide sense that we should learn from Nature's insistence on health.

14. It is plain, of course, that there are many hints in Nature's régime which Man cannot follow, especially for the one big reason that what is biologically desirable may not be justifiable socially. Man cannot consider the analogues of killing off the drone-bees or devouring the wasp-larvæ when winter approaches. Man cannot surrender parts as a crab its damaged leg or a starfish its captured arm. Man cannot pass into stages of prolonged rest or hibernation as many animals do in hard times. Man cannot indulge in the extraordinary internal disruptions and reconstructions of organisation that enable animals of lower degree to stave off senescence. But because we cannot do such things there is all the more need that we should do

what we can in fostering an enthusiasm for health which will find, e.g. in change and play, its own prescriptions, and can always call science to its aid.

15. Three general ideas, familiar to biologists, should be borne in mind: (*a*) Enthusiasm for health must respect the unity of the organism, which is body-*mind* as surely as it is mind-*body*. (*b*) No progress in health or sanitation, or aught else, can be really secure which does not respect the biological trinity of Organism, Function, and Environment; Famille, Travail, Lieu; People, Work, and Place. (*c*) While no one dare set limits to what "Nurture" (i.e. all manner of extrinsic influences—environmental, nutritional, occupational, educational, etc.) may do for the hereditary "Nature" of the individual in the way of inhibiting buds of evil portent and encouraging those of good promise, this can never change bad seed into good. "You cannot make a silk purse out of a sow's ear." On the other hand, desirable nurtural effects can be re-impressed on successive generations. Moreover, for civilised mankind the Social Heritage is as supreme as the Natural Inheritance is fundamental, and affords many opportunities for transcending the trammels of protoplasm.

16. The practical absence of disease and senility in Wild Nature is enough to show that these cannot be regarded as ills that the flesh is *necessarily* heir to. The insurgent healthfulness throughout Nature is a positive ideal to which Man *can* return. But there is another and deeper aspect of our theme—*Vis medicatrix Naturæ*. If Nature's régime be all for health, there is reason to conclude that the momentum of Organic Evolution is in the direction of what we call Progress in mankind.

It may be said that there are two great *pre-conditions* of human progress: (*a*) the physical pre-condition of wealth; and (*b*) the biological pre-condition of health. By wealth is meant a mastery of the energies of Nature, an increase of material resources, and notably also an increased economy in their utilisation.

But after the pre-conditions have been recognised, what is meant by human progress? The racial consciousness at its best has persistently given the answer, that progress means a broad and balanced movement (not a caste or class movement) in the direction of a fuller embodiment of the higher values—the True, the Beautiful, and the Good—a realisation of which makes a human life increasingly a satisfaction in itself.

Organic Evolution has been in its main trends persistently *integrative*—that is to say, it has made for stability, unification, harmony. It has persistently made for the elimination of the disintegrative, the unharmonious, the inconsistent, the ugly. As William Watson has said incomparably well:—

Nay, what is Nature's
Self but an endless
Strife towards music,
Euphony, rhyme.

Trees in their blooming,
Tides in their flowing,
Stars in their circling,
Tremble with song.

God on His Throne
Is Eldest of poets;
Unto His measures
Moveth the whole.

It is a safe thesis that all wild creatures living independent lives, fully formed and healthy, and apart from Man's influence, are things of beauty. That is to say, they excite in us the characteristic æsthetic emotion, especially if we see them in their natural surroundings. There is much to be said for the view that beauty is metaphorically Nature's

seal of approval on orderly growing and living; even, as in the case of withering leaves, on well-regulated dying. The withering of the "flowers of the forest" is like the dying-away of music! In Wild Nature the seal of beauty is practically universal except where Man has blurred it with his fingers, frequently as careless as they are skilful.

Organic Evolution favours strength and cunning, the sharpening of tooth and claw and the quickening of wits, but it also favours parental care and mutual aid. For the Struggle for Existence includes *all* the answers-back which living creatures make to environing difficulties and limitations; it includes co-operative as well as competitive tactics. So it may be said that the trend of Organic Evolution has given the premier place—to Birds and Mammals, for instance, among Vertebrates—that is to say, to organisms that are good parents, good mates, or good kin. And here we have the primordia—the incipient tissue—of ethical goodness.

And as to Truth and Truth-seeking, has not Nature persistently rewarded those organisms which faced the facts, which got to know their surroundings? And here is the beginning of Science. Has not Organic Evolution always favoured clearheadedness? Organic Evolution has been an

age-long obedience to the precept: "Test all things, Hold fast to that which is good." And it does not seem far-fetched to say that Truth-seeking is a natural and necessary activity of the healthy-minded organism, which will not tolerate obscurities and which is restlessly inquisitive. If so, it is in line with the healthfulness that Nature has always made for.

We must not follow the argument farther, but we are in sight of a very important conclusion, that the main trends of Organic Evolution, *against* which Huxley said that Man at his best must set himself, are really in man's favour, are actually congruent with the highest ideals of humanity. This is the deepest aspect of *Vis medicatrix Naturæ.*

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